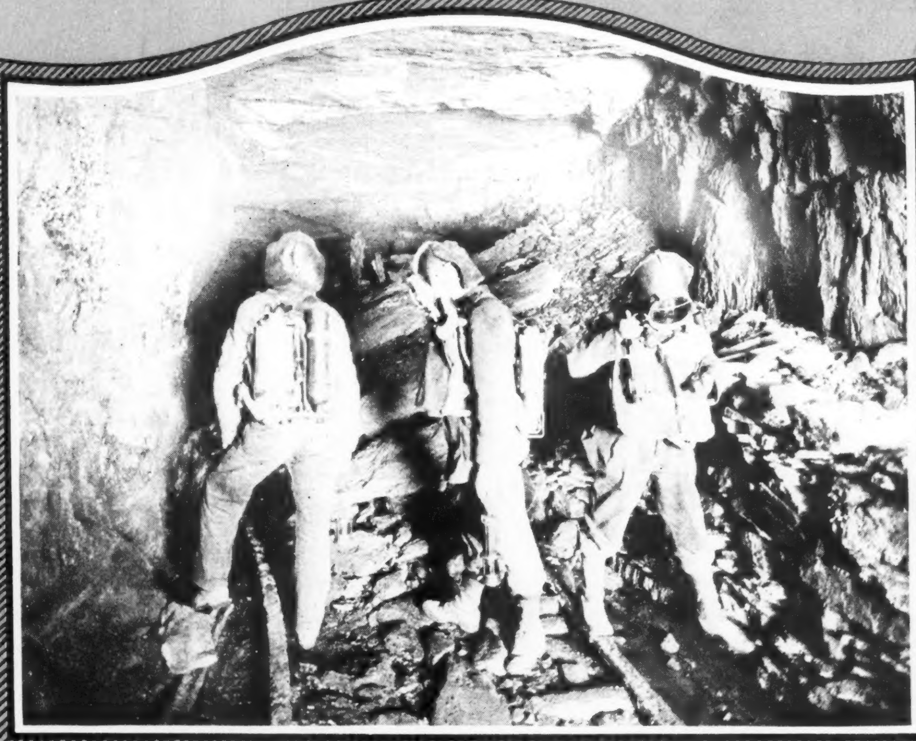
Compressed Air Magazine

Vol. XXX, No. IX London New York Paris 35 Cents a Copy

SEPTEMBER, 1925

CIRCULATION THIS ISSUE
25,241 COPIES



DANGERS INCIDENT TO INSPECTING A GAS-FILLED COAL MINE ARE MINIMIZED BY THE USE OF SPECIAL EQUIPMENT

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Compressed Air Magazine

NEW YORK · LONDON · PARIS
Principal Offices:
BOWLING GREEN BUILDING
No. 11, BROADWAY,
NEW YORK.

VOL. XXX, NO. IX

SEPTEMBER, 1925

Compressed Air Speeds Up Chrysler Car Production

Air-driven Tools and Pneumatic Machinery of Many Sorts are Used to Maintain a High Rate of Output

By R. G. SKERRETT

MORE than 15,000,000 passenger automobiles are in well-nigh daily service in the United States. It is probably not an exaggeration to say that ten times that number of people use those cars in the course of a twelvemonth; and of these 150,000,000 persons hardly more than a small percentage of them have any conception of how these power-driven vehicles are built and placed at the public's disposal in continually increasing numbers.

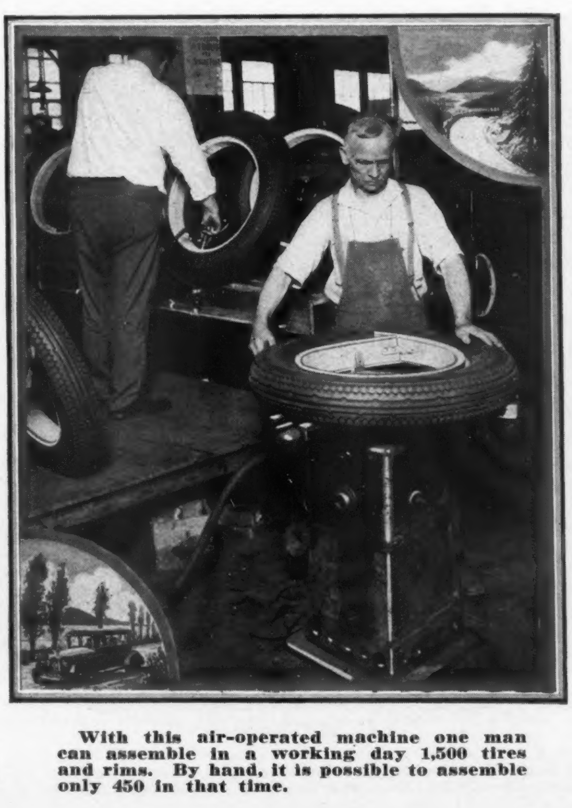
The purpose of this article is to reveal to our readers something of the up-to-date processes and the highly developed methods employed in one of America's most progressive motor-car plants. There was a time when this amazing industry was content to save minutes in the course of any given operation; today, the aim is to clip off seconds, because any time saved means greater profits and a larger circle of satisfied customers.

We shall be the better able to appreciate what the car manufacturer is now doing if we recall the way in which our automobile industry has developed within the astonishingly brief period of three decades. Just think of it! In 1895 there were but four passenger automobiles officially registered in this country. At the close of 1924 there were registered no fewer than 15,460,649 cars of this kind; and the vast majority of those cars had been built within the last ten years.

It is authoritatively estimated that our automobile manufacturing plants represented at the end of the year gone a capital investment aggregating more than $1,690,000,000; and it seems that the industry then gave direct employment to nearly 2,894,000 people, while it was indirectly responsible for the occupations of 226,000 other persons.

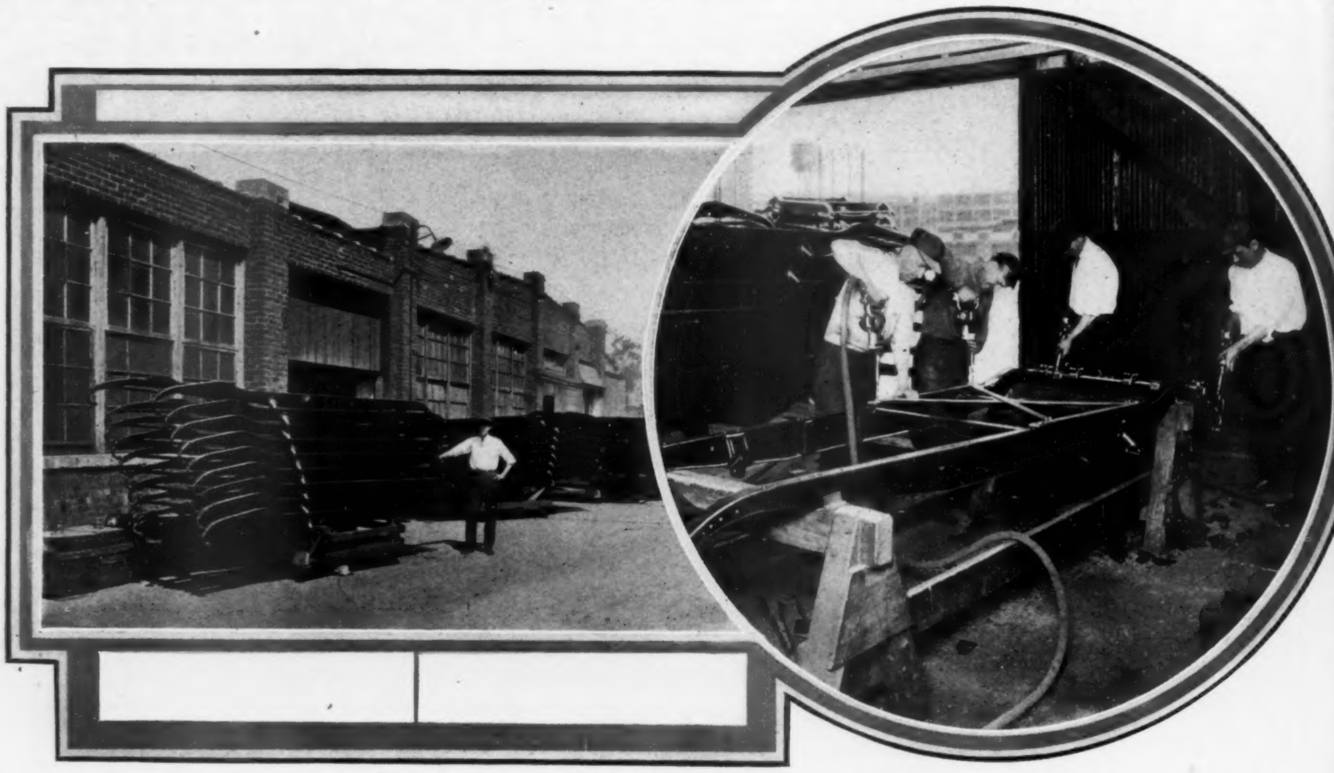
The first thing that we should bear in mind is that the building of automobiles is an extremely competitive business. This is largely due to the fact that the business rests fundamentally upon popular appeal, and everything must be done that can be done to win the favor of the largest practicable following. The public is today decidedly exacting—demanding for every dollar spent as much in return as it can get. Not only that, but this self-same public has become very discerning and highly discriminating; the majority of these people know what they want and insist upon getting it before they open their purses.

This state of mind lays a heavy burden on the manufacturer, because failure to perform well over a more or less arbitrary period of service quickly provokes discontent and a disparagement which is soon broadcasted from end to end of the land. Therefore, the builder knows that he must turn out a car which will stand up well under widely varying conditions of use; give satisfaction to the owner; and, at the same time, permit the manufacturer to make a reasonable profit even when offering his product at an attractive price.



With this air-operated machine one man can assemble in a working day 1,500 tires and rims. By hand, it is possible to assemble only 450 in that time.

Although many of us accept the motor car as a matter of course and show but little interest in how that car is made available, still there are some of us that sense the magnitude of the job represented by the industry as a whole, and they are curious about how things are done in the factory. These people ask—and with reason: "How is it possible for the manufacturers to turn out cars fast enough to meet the augmenting demand? How is it practicable to build these cars quickly and, withal, structurally so sound that they may be safely entrusted to the management of hundreds of thousands of persons possessing little if any knowledge of machinery?" It won't be possible within the limits set us to touch upon more than the high spots of a topic crowded with interesting and astonishing performances. Much that is worth telling cannot even be referred to. In a general way, we can pay only a passing tribute to the skill of the designing engineer or to the cunning of the metallurgist who picks out metals possessing just the right physical characteristics wherewith to fashion, with the least acceptable weight, a variety of essential parts capable of meeting the diver-



Left—How the chassis frames look when they are first delivered to the assembling department of the Chrysler plant. Right—Drilling rivet holes through the longitudinal and the cross members of a chassis frame.

sified stresses to which they would be subjected in service.

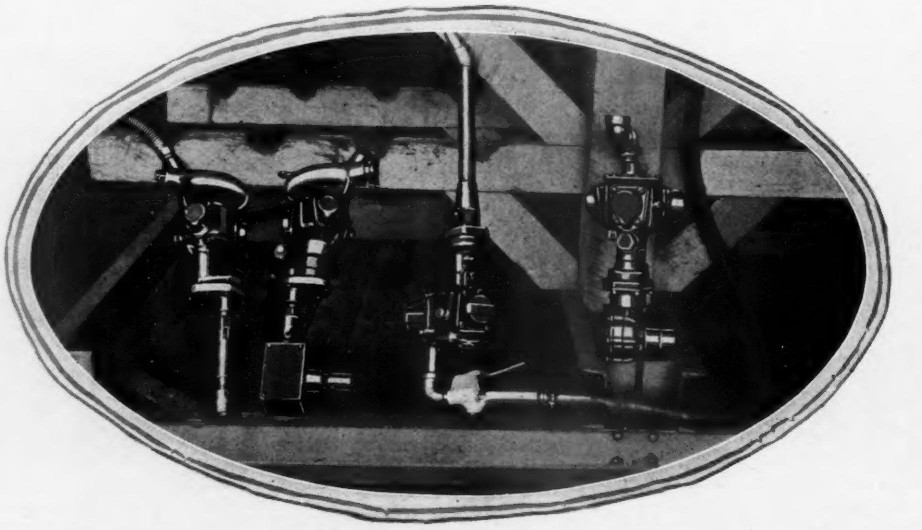
Our purpose is to carry our readers on a sightseeing tour through the Detroit plant of the Chrysler Motor Corporation where, so we are told, compressed air is used in more ways than is the case in any other establishment of the kind. Indeed, one of the supervisory officials does not hesitate to say that it would be impossible to obtain the same fine results in quality and quantity of output without recourse to the widest use of compressed air.

The Chrysler plant is a splendid example of intensely systematized effort. This can be appreciated when it is recalled that the company produced the first of its cars only so recently as December of 1923, and during the first twelve months turned out cars at the rate of 250 a day. Indeed, the plant was originally designed to fabricate but 75 cars a day; but, by the adoption of carefully coördinated efforts; by the use of many labor-lightening facilities; and by making the most of every inch of the 650,000 square feet of floor space, the plant capacity has been raised to a maximum of 390 cars a day. A force of 3,500 people is concentrated upon the task so represented.

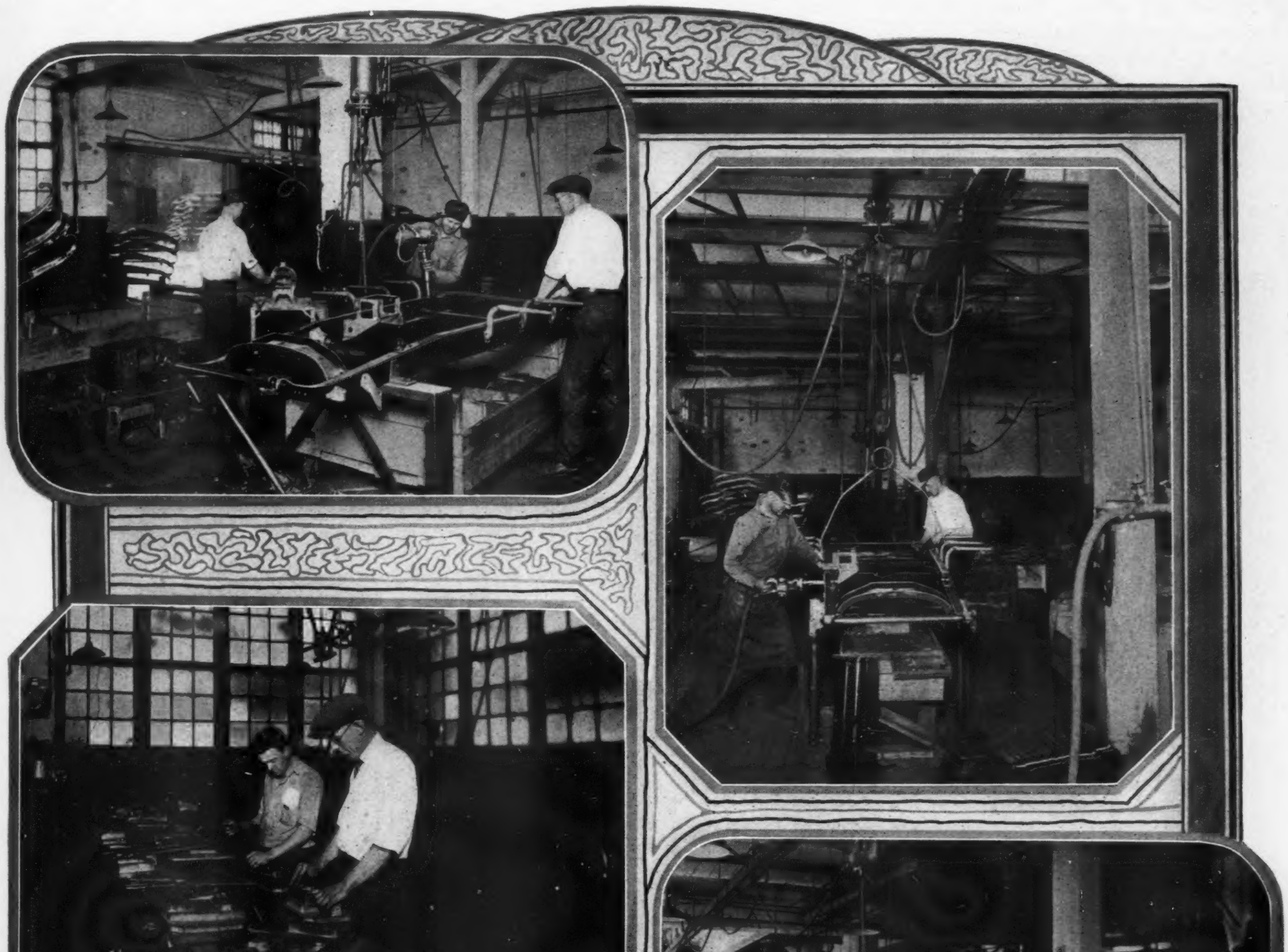
Undoubtedly, these results are, in the main, due to the outstanding directive genius of Walter P. Chrysler and to his exceptional discernment in choosing the men to work with him. The spirit of teamwork is evident in every department of the plant—there is plenty of evidence of haste but none of hurry, because each man's work is timed to a nicety to keep pace with that of his fellows.

Every Chyrsler car is made up of 5,600 separate parts; and by the methods adopted at the plant all these parts can be assembled and a complete car produced ready for shipment in the course of only two hours and forty minutes of work! It should be understood, of course, that much more time is necessarily required to make those 5,600 separate parts ready for assembling. Even so, the actual assembling is none the less a cause of wonderment. The fact will be self-evident to any car owner that has done even a moderate amount of overhauling and tinkering with his car.

To avoid confusion, we shall follow the various steps by which a car grows from the chassis frame to the finished and the tested vehicle ready for shipment. The photographs used with this article will help greatly to make the procedure clear to the reader. Let us start in the frame and tubing assembling department. There, the fabricated side frames, the associated transverse tubing, and other structural features are brought together by riveting and bolting to form what may properly be called the foundation of the vehicle. In doing this work, air-driven riveting hammers, air-operated drills, and other pneumatic tools serve to do the needful riveting, the drilling of holes, and the running down of nuts on threaded bolts. From time to time, the growing frame is lifted and shifted to other positions by means of air-operated motor hoists which lend themselves readily to changing loads and to a wide variation in the length of lift—differing in this particular from pendant pneumatic piston hoists. The same type of frame is used for all models of Chrysler cars, but the



Some of the many Ingersoll-Rand pneumatic tools that figure largely in that high order of workmanship which characterizes the assembling of Chrysler cars.



Top, left—Riveting step hangers, battery-box supports, etc., on the side frames of a chassis.
Top, right—Drilling rivet holes in side frame. Note air-motor hoist and overhead rail to facilitate shifting work from point to point.
Middle, left—Hardwood-forming fixtures used in bending copper tubing for hydraulic brake system.
Middle, right—A stage further along in assembling the chassis: securing the muffler and the exhaust pipe.
Bottom—Various ways in which copper tubing is bent for the different parts of the hydraulic brake system.

frames are assembled differently to meet the special requirements of each model.

In this same department, stephangers, battery-box supports, body brackets, fender brackets, and brackets for the stabilators are riveted in place; and here also is assembled the tubing of the hydraulic four-wheel brake system. By an ingenious arrangement of hardwood forming fixtures, the copper piping is bent quickly, exactly, and repeatedly to the shapes required. The leaving the factory, at a pressure of 650 pounds to make certain of a very liberal factor of safety in service. Compressed air is utilized to build up the test pressure exerted upon the mixture of castor oil and alcohol which constitutes the fluid medium by which the pressure of the driver's foot is instantly transmitted to the brake on each wheel. We might also mention that a tolerance of only three thousandths of an inch is allowed in the of workers. The carriers are pulled onward by a chain belt driven electrically. At a point, these carriers pass at the rate of a change of position every two minutes. Here we see each chassis acquiring new features every few seconds; and the work is carried on in so orderly a fashion that there is not the slightest evidence of confusion. The procedure is a striking example of well-directed correlated efforts.

Left—Each engine is run a total of six hours on a testing block to ascertain whether or not it is mechanically perfect.
Right—By means of an air hoist, each body is carefully lowered onto its intended chassis and then made rigidly secure by air-driven tools.
Bottom—When fully assembled and equipped each car undergoes a series of exacting tests that determine the vehicle's fitness for the market.

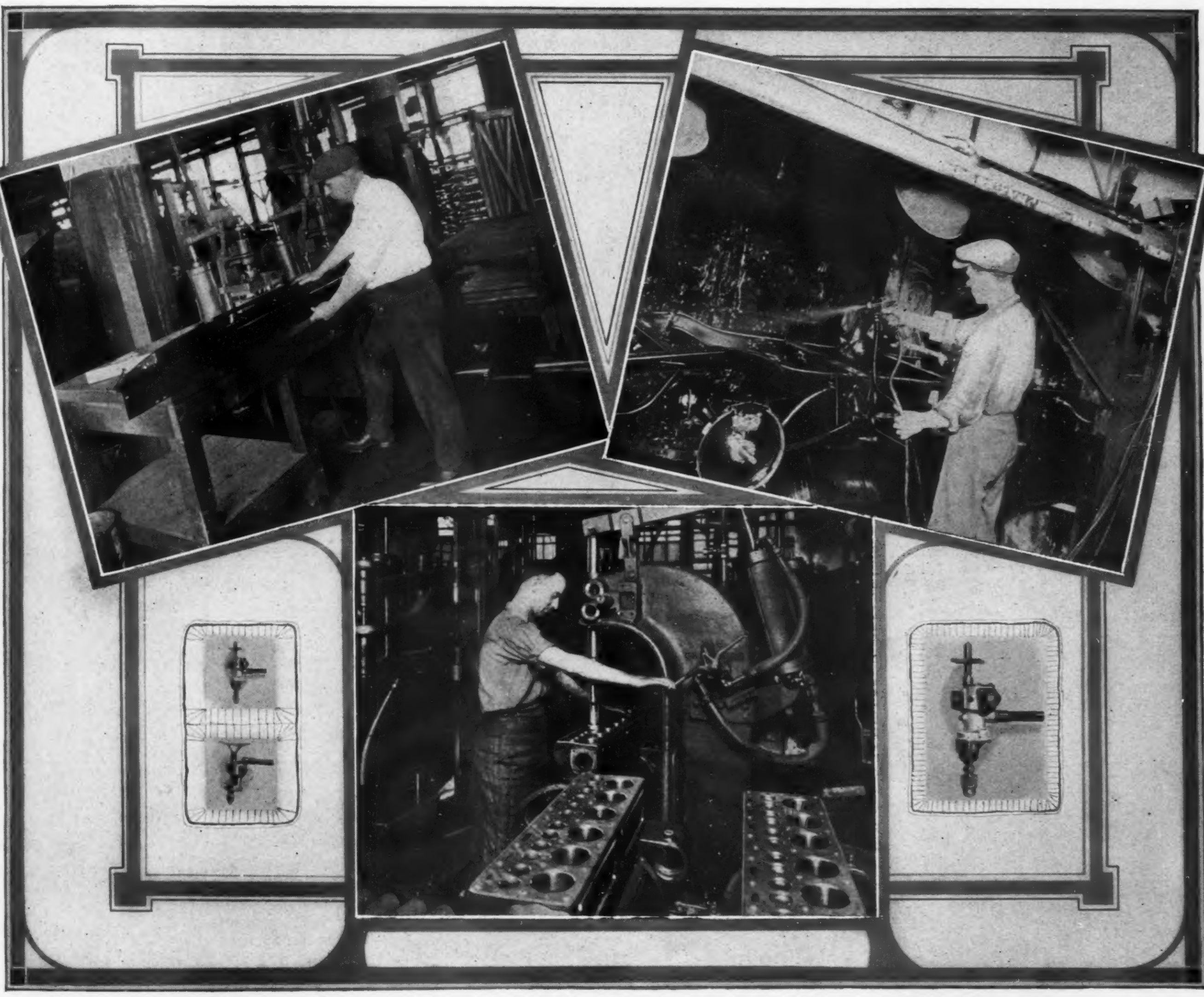
sizing of the tube ends for the several compression joints is done with a small air-operated hammer; and compressed air also flares the ends of this piping so the sections will fit into the ferrules which compose parts of the joints. Furthermore, a forceful whiff of compressed air serves to blow the tubing free of any internal scale.

It is worth noting at this point that although the hydraulic braking system operates ordinarily at a maximum pressure of 200 pounds, still each of these installations is tested, before finished brake drum. This accuracy makes the brakes function well and wear well, and what is even more important, it insures an evenness of application on all four brakes at all times.

From the frame and tubing assembling department, the chassis frames are transferred to what is known as the "first assembly line." This line is made up of a string or train of carriages which travel from one end of the shop to the other, and at each stage of advance something different is done by a separate group

In this shop can be seen some of the many uses to which air-motor hoists are put in the plant. These hoists not only lift and lower the chassis from time to time, but, by means of ingeniously arranged slings, the hoists raise the chassis and turn them over so that the workers may perform their different allotted tasks with more certainty and more speed. Next, a preliminary or sub-assembly operation is performed which consists of bringing together the axles, the springs, the brake bands and the hydraulic cylinders—the nuts being

un down with air tools just hard enough to old the several parts together until the springs re assembled to the brackets on the frame yet llowing sufficient adjustment to insure perfect lignment of the spring or shackle bolts. The ssembling of the rear and the forward axles re separate jobs. With the foregoing work ompleted, the nuts are then tightened hard nd firmly secured with even more powerful ir-driven motor drills. The latter work is one simultaneously by six men. The nuts se-



Left—Air-operated twin punches punching holes in splash guards for kick plates.
Right—Spray painting makes quick work of coating every part of a chassis.
Bottom—An air-driven press forces the valve-stem guides into place in the cylinder block.

cured in this way are seated far more tightly than it is commonly practicable to do so by hand, hour in and hour out, throughout the whole of a working day.

The Superintendent of Assemblies, Mr. C. F. Lozon, when asked why he employed air-driven tools so extensively, explained that he could not begin to turn out cars at the plant capacity and of the high standard of workmanship insisted upon if he had to resort to hand methods. As he expressed it: "The air tool has no equal. It performs just as well at 5 o'clock in the afternoon as it does at 8 o'clock in the morning—unlike the hand worker who tires in the course of a busy day and is apt to slacken up and, perhaps, to skimp his work unintentionally as his muscles weary and his energy lags."

Most of these air tools are suspended and counterweighted so that they can be raised and lowered and swung to any desired position with the utmost ease. Many of these tools are equipped with special attachments which make it possible to bring them effectively into service in tightening bolts located where it would be well-nigh impossible to do the work quickly and effectually by manual adjustment.

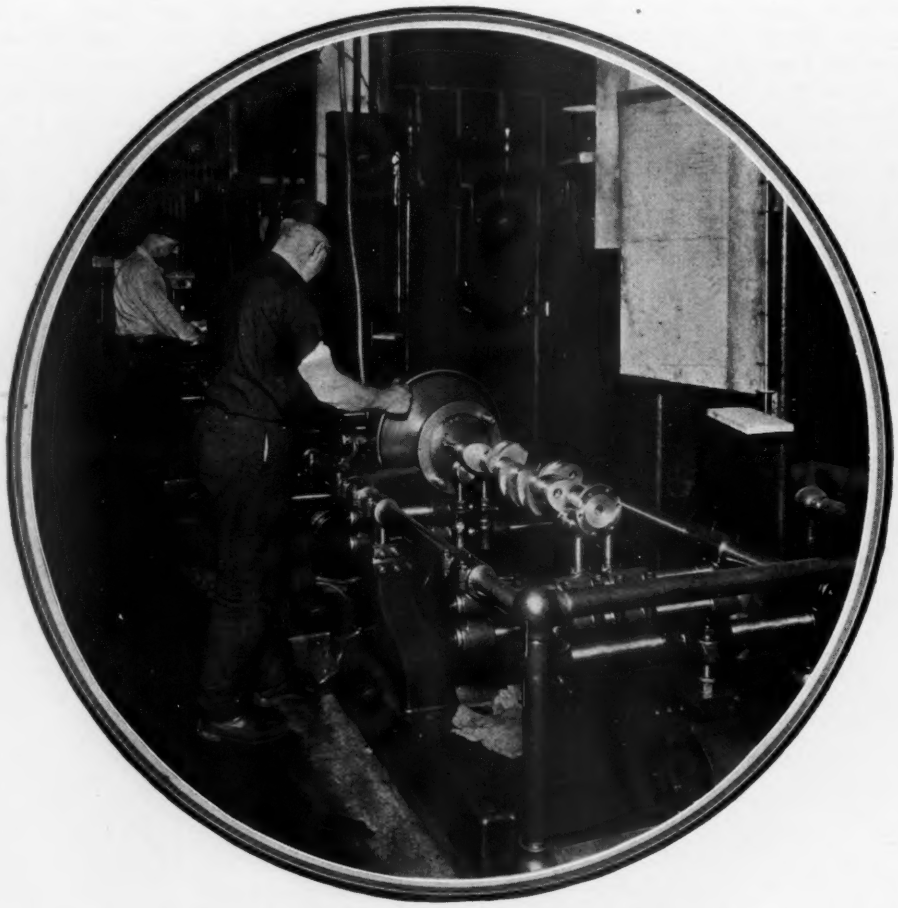
To the customer the foregoing explanation should be of more than passing interest, because it is upon the security of these nuts and bolts that the strength and the proper performance of the car depends in no small measure. A loosened bolt may cause something more serious than a squeak or a rattle—it may invite breakdown and, possibly, a disaster. Accordingly, a driver that takes his car over all sorts of roads and has to speed it onward under adverse circumstances can feel more confidence, be surer that he will reach his journey's end without structural failure, if every nut and bolt is made as tight as powerful air-driven tools can make it. In short, the car that is assembled in this manner is a dependable product; and at the Chrysler plant there is no difference, in this respect, between the first car turned out in the morning and the last car put together before the working day ends.

What is equally important, from the manufacturer's point of view, is that relatively untrained labor can be quickly qualified to do excellent work. That is to say, it takes only two days usually to train a green hand to do first class work. This is made possible by utilizing air-driven tools, by standardizing that equipment, and by developing simple methods which can be rapidly and surely mastered by the worker.

When the assembling of the chassis has reached a certain point, the chassis enters the painting booth, where every part of it is given a substantial coat of black. This painting is done by air sprays, and thoroughly done by two men in the course of only two minutes—

the atomized paint being forcibly directed onto every inch of surface and into every recess in a way that the painting could not be done by hand in the course of several hours. The paint is sprayed with air at a pressure of 50 pounds; and the two operators can paint 300 chassis in the course of a working day.

After painting, the chassis moves into a tunnel-like oven which is heated with steam to a temperature of 190°F. Half an hour later the chassis issues from the far end of the oven. The chassis is next shifted to the second assembly line. Here it receives, successively, the harness for the wiring, the battery, the fender, the splash guards, running boards, etc., etc. In all this work air-driven tools are used wherever practicable. In fact, compressed air operates the hoist which raises the chassis from the ground floor to the second floor of the plant.

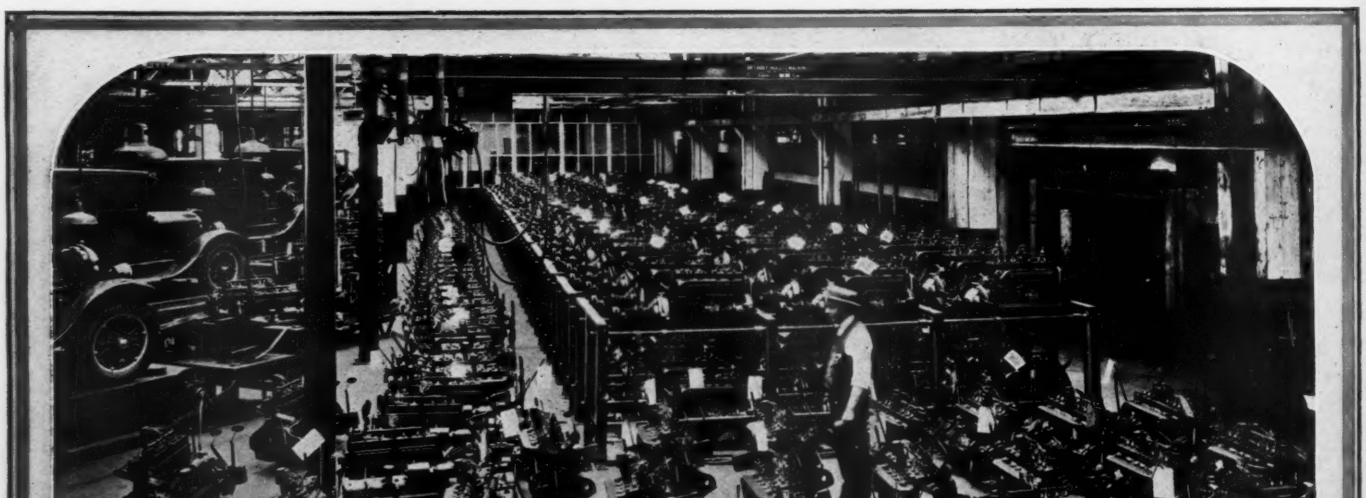


The purring smoothness of the speeding Chrysler engine is largely due to the perfect balance of its crankshaft. Here we see a crankshaft undergoing test in a machine which detects any lack of balance and indicates where and how much metal must be removed to insure equipoise among the several cranks. This is a nicety of manufacture that means much to the car owner.

In order to standardize the performance of air tools so that they shall exert a predetermined maximum pressure when running down bolts, the air for this purpose is drawn from an air bottle in which the pressure is built up to a suitable point, with sufficient volume, to meet the needs of the workman. In brief, the air bottle acts as reservoir, and insure enough air at all time and neutralizes any re sistance which might b experienced if the ai were taken directly from the regular air line.

When the chassis ha reached a prescribed stag of readiness, the alread assembled body is low ered onto the chassis b an air hoist—the body descending from th third to the second floor Again, air-driven tool secure the body to th chassis; and each of thes operations is a piecewor job which is paid for o a bonus scale system which is based upon series of time studies This arrangement stimu lates not only teamwork but the best efforts o the individual worker and the more a man doe the more he earns.

Inspection is a contin uous performance no only on the part of th inspectors but on the par of the workers them selves. That is to say every workman is in duced to do his work s carefully that he is vir tually an inspector; and every man is held ultimately responsible for the workmanship on his particular job. In case of faulty or im-



An array of scores and scores of finished and carefully tested 6-cylinder engines ready to be placed in Chrysler cars.

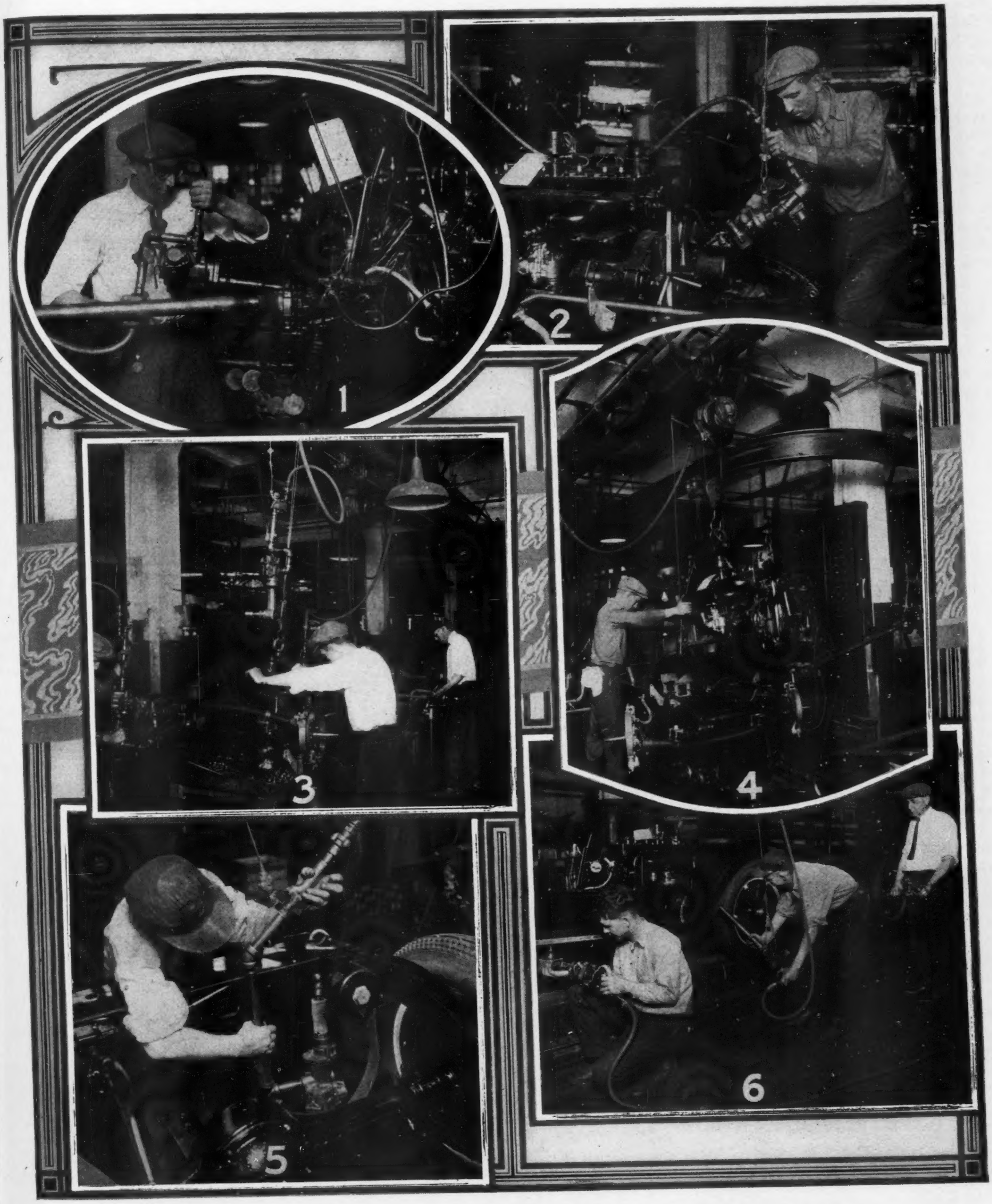


Fig. 1—Tightening bolts of universal joint on propeller shaft.
Fig. 2—A difficult assembly problem solved by using an air drill with special attachment.
Fig. 3—Assembling axles, springs, and brake bands.
Fig. 4—Lowering an engine into position on a chassis by air hoist.
Fig. 5—Air drill, with special rig, runs home bolts on stabilator.
Fig. 6—Air drills lighten and speed up assembly work.

perfect workmanship, the man accountable must make it good or be docked accordingly.

The wheels are assembled on the third floor of the plant. The tires and rims are assembled with the aid of a simple arrangement of three air-operated pistons which contract the split rim on itself so that the tire can be quickly dropped around it—immediately afterwards the rim is allowed to expand again and is locked. One man, with this pneumatic apparatus, can make 1500 assemblies in the course of a day where formerly but 450 operations of the kind could be done in the same period. The assembled tires and rims are next assembled on the wheels. The wheels are then dropped from the third floor to the first floor by way of a vertical chute equipped with shifting horizontal rollers which cause the wheels to zigzag in their downward course and to deliver them without violence at the bottom outlet. The wheels are then placed upon the axles of each chassis as the chassis comes from the drying oven.

The painting of the bodies, the hoods, etc., is done with spray guns except in the case of the decorative fine lines—these lines are run in by hand. The arrowhead or spearhead markings on wheel spokes are spray painted—stencils being used for the purpose.

The spring shacklebolts, the universal bolts of the propeller shafts steering gear, the steering spindle bolts, wheel bearings, etc., are all forcibly greased under a pressure of 1,200 pounds. This pressure is built up by the action of air at a pressure of 80 pounds.

Before telling of the final tests that a car must pass before it is pronounced ready for shipment, let us touch briefly upon some of the things done in the wonderfully equipped machine shops where the driving engines are turned out and rigidly tested to make sure that they are fit to be installed in Chrysler cars. We have not time to go into the foundry where engine castings are made and where compressed air is employed in numerous ways to speed up work and to insure excellence in the products. Broadly stated, in the machine shops the various parts are handled in groups or multiples as far as this can be done, and thus one operator can supervise the simultaneous milling or machining or drilling of a number of cylinder blocks, and another man can control with equal success the boring, the grinding, etc., of four or more of these master parts of the Chrysler six-cylinder engines. Even though this work goes forward rapidly it is performed with great precision. Tolerances of only one-half of a thousandth of an inch are permitted in the case of the pins of the main bearings; and wrist pins must not vary more than three-tenths of a thousandth of an inch from the prescribed dimensions. This accuracy is assured through the continuous supervision of inspectors who test every gage every day; and every gage in service is counter-checked by master gages which are kept in the tool room.

Compressed air does many things in the engine-building department. Numerous air-operated motor hoists constitute flexible and ready means by which the parts under treatment are lifted and shifted from point to point during different stages of machining and assembling. Compressed air functions the chucks on lathes and other machine tools—thus saving time and lessening the tax on the muscles of the machinists; and compressed air is used to hold in place the cylinder heads while they are being subjected to the prescribed hydraulic pressure test. Air-driven drills run in place 16 tap screws on each cylinder block; and because this work is done in this way it is possible to put through the shop 269 engine-assembly jobs in the course of a nine-hour day. Valve stem guides are forced into their positions—seated, as the shopman expresses it—by a pneumatic press. Indeed, compressed air is utilized as far as possible consistent with the capacity of the compressor plant, which has an output equivalent to 4,000 cubic feet of free air per minute. Incidentally, we might mention that compressed air is employed in testing for tightness both the gasoline tank and its associate piping.

When the cylinder blocks have been finished machined they are cleaned with compressed air and live steam; and then they are ready to receive certain parts and fixtures. During all these steps, the growing engine is traveling forward well-nigh continuously on a given course; and when the motor is completely assembled it goes to the testing room, where it is mounted and directly connected to another engine of the same sort which serves as a prime mover. For three hours the "green" motor is driven by the other motor, which was previously a "green" one, and in this way the moving parts of the newer engine are "lapped in" so that they will run smoothly. With this test period ended, the erstwhile "green" motor is hooked up as a prime mover and drives another engine for a period of three hours. During all this time, the performances of both the driving and the driven engines are carefully watched and any imperfections noted either for immediate or later correction.

When this six-hour test period is ended, and the engine found satisfactory or made so, it is shifted to a compartment where it undergoes what is termed the "silent test." In this room the motor is mounted in a way to reproduce the conditions under which it would work in a car, and it is connected with an electric dynamometer. The six-cylinder engine must show a sustained torque equivalent to 90 pounds when making a thousand revolutions a minute. This means when running at the rate of 2,800 revolutions a minute the engine will develop 65 brake horse power. Assuming that the engine has passed this test, it is then ready, after a few final touches, to be shifted to the car-assembly department where it is held in stock preparatory to taking its place in one or the other models of six-cylinder cars built by the Chrysler Motor Corporation.

When the car comes from the final assembly line, its gas and oil tanks are filled, and the car made ready for final testing. The block on which the cars are tested is, in effect, a sort of treadmill which is so arranged that the rear or driving wheels of a car turn other wheels upon which the driving wheels rest. The driven wheels can be controlled by a braking equipment, and this arresting check is varied so that the load on the car's engine may be altered to simulate the load to which it may be subjected when traveling over different roadbeds and on different gradients. This test also serves to test the car's brakes and to disclose the need of any adjusting.

With the foregoing test ended, each car is then driven over a grid made up of a series of cross ties which gives the car a pretty severe shaking and generally suffices to reveal any loose bolts or any other imperfectly secured features so that they can be properly dealt with at once. After leaving this multiple "thank-you-marm," the car is driven to a platform where it rests on a series of rolls whereby the axles are tested. One of these sets of rolls is mounted eccentrically, and as they are revolved by the car's driving wheels they produce a decidedly vigorous up-and-down movement. This causes the car to act much as it would on a bumpy roadway, and the axles must be in perfect condition to withstand the blows thus imparted to them. When a car has gone through all these tests successfully, then it is passed by the last of the inspectors and declared fit for immediate shipment.

Enough has been said to make it plain to the ultimate purchaser of a Chrysler car how it is possible to turn out these cars rapidly, to fashion them correctly in every particular, and to make them strong enough and flexible enough to meet the widest ranges of service. Nothing is taken for granted: every step in the car's construction is systematized, standardized, and carried out with the utmost care.

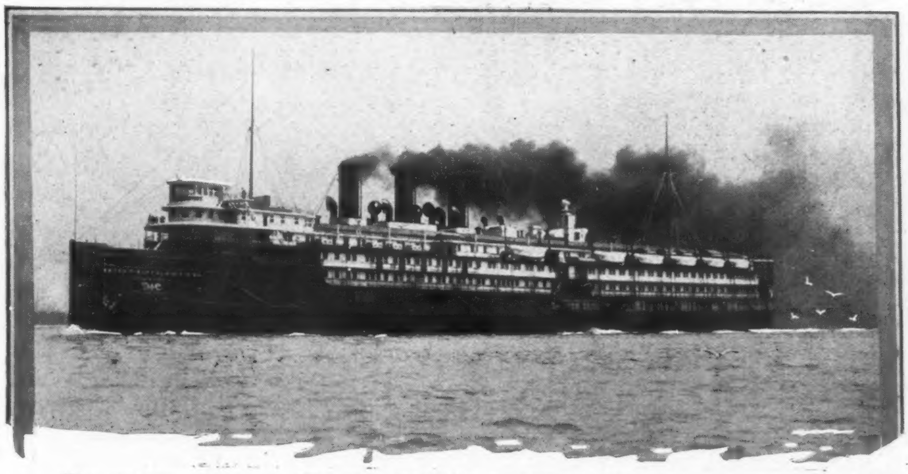
These results could not be realized if labor-lightening facilities were not utilized wherever possible; and in the ultimate success of these wonderfully focused manifold efforts it should be self-evident that compressed air plays a decidedly conspicuous and helpful part.

SURE SIGHT FOR THE NAVIGATOR

ONE of the most responsible positions in the world is that of the man on the bridge directing the course of a great ship. For him, clear, certain and unobstructed vision is imperative at all times, and especially so in a driving storm when sight is most difficult. His eyes must be protected as he looks out, and a clear sheet of glass is the obvious suggestion. But rain and spray and snow drive against the glass and accumulate upon it, and the most constant wiping of the surface, even by the most untiring mechanical devices, is often of little avail. Suddenly and quite recently there has come a solution of this perplexity and, as usual, a very simple one. A polished glass disc, rotated by an electric motor at such a speed that nothing can be deposited on it that will adhere for an instant, is the solution of the problem. The device is being manufactured by a responsible English firm and distributed on both sides of the Atlantic.

Air-Operated Sounding Machine Lessens Marine Hazards

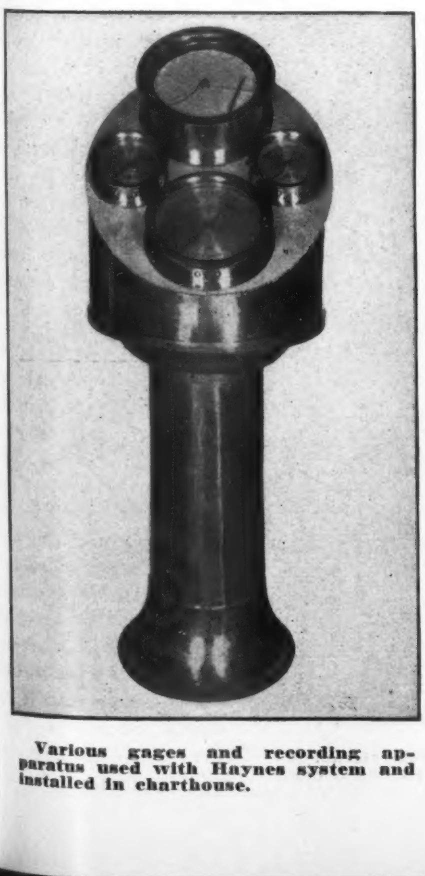
By A. B. SEAMAN



The express steamer "Greater Detroit" is equipped with a Haynes automatic sounding machine to make safer her voyaging upon the waters of the Great Lakes.

WHEN running well off shore, the navigator can keep tabs on the general position of a ship by the use of deep-sea sounding apparatus which measure more or less frequently the deepness of the water. When nearing a coast or when threading comparatively narrow waterways, the man on the bridge establishes the fact that he is following a safe course only by recourse to the repeated heaving of the hand lead-line. This procedure has various drawbacks, and to lighten the responsibilities of the navigator there has been devised what is known as the Haynes Automatic Sounding Machine.

This machine is decidedly simple in its get-up, and its operation rests basicly upon that well-known principle of hydrostatics which reveals a direct proportional relation between the depth and the pressure developed at any depth in a body of water. That is to say, the pressure at 20 feet below the surface is twice the pressure encountered at 10 feet, while the pressure at 100 feet is ten times that recorded at 10 feet.



Various gages and recording apparatus used with Haynes system and installed in charthouse.

The Haynes apparatus functions continuously, and is composed of the following essential features: a reel or drum—power driven—upon which can be carried several hundred feet of armored hose of a special design; an engine or motor for turning the reel; a suitable opening, with a standpipe, in the bottom of a craft through which the hose can be dropped outboard or retrieved; and a small air compressor providing air which can be forced outboard through the hose at any operating depth. The pressure required to force the air downward and out through the trailing nozzle of the hose being duly registered in the charthouse by a suitable gage which can be set to sound an alarm whenever the nozzle trails along the waterbed at a predetermined depth—thus warning the mariner that he has reached soundings which call thenceforth for watchfulness if he continue upon that course.

It should be readily grasped that the action of the compressed air is to force the water out of the tube which would otherwise invade the tube, and the force developed for this purpose must slightly overbalance the pressure of the surrounding water at the outlet point. In order to obtain more accurate readings at the gage in the charthouse, and to avoid pulsations which would interfere with this if the air entered the sounding tube directly from the compressor, the plant includes an air receiver or reservoir which stabilizes the flow of air and also provides a reserve of air to take care of an emergency should the compressor be stopped pro tem.

For the sake of example, let us assume that the navigator wishes to be advised, during foggy weather, when his craft reaches water having a depth of 100 feet. The armored hose is lowered through the bottom outlet and long enough to hold the discharged nozzle at a depth of approximately 100 feet when moving forward at a fixed speed. The moment the nozzle touches bottom at the 100-foot mark, an electric mechanism sounds the alarm, and from that moment onward the change of depth is indicated by the shifting of an indexed hand. Checking these readings by means of a chart and the direction in which the vessel is bound, it is an easy matter for the navigator to ascertain his position so that he can either alter his course to escape danger or keep straight on confidently knowing that he is correctly and safely headed for his chosen port.

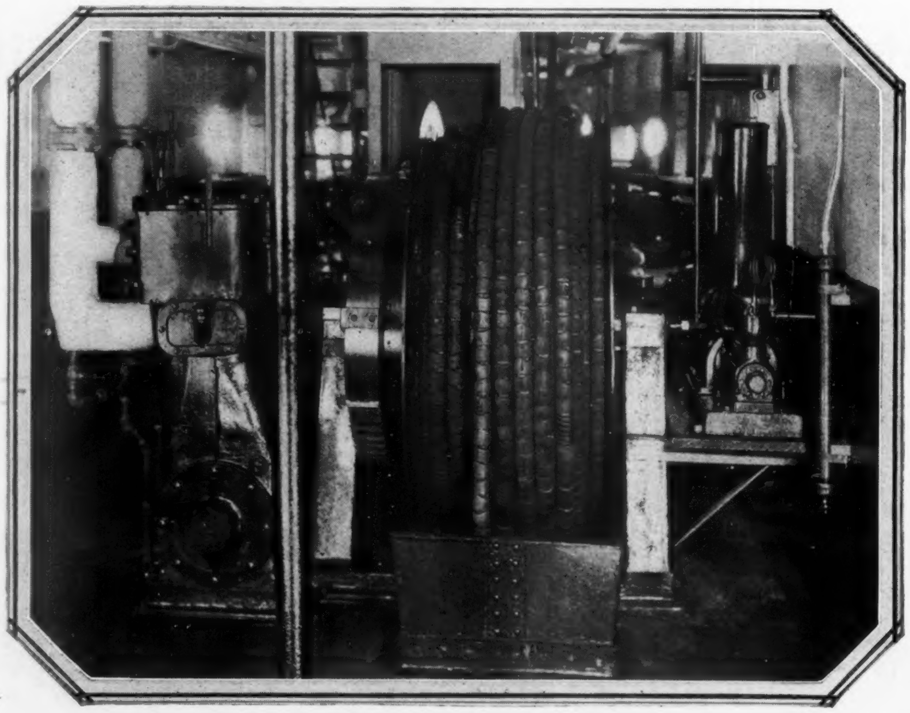
For the sake of those interested in structural details, let us see how the sounding line or sounding hose is formed. The inner core of this conduit is made of rubber, specially compounded to withstand the destructive action of air and water. This core is primarily protected from the crushing action of enveloping water by a series of steel ferrules which, in turn, are separated by heavy steel compression rings.

Casting and pipe connection forming the outlet for the sounding line where the hose passes outboard through the bottom of a vessel equipped with the Haynes apparatus.

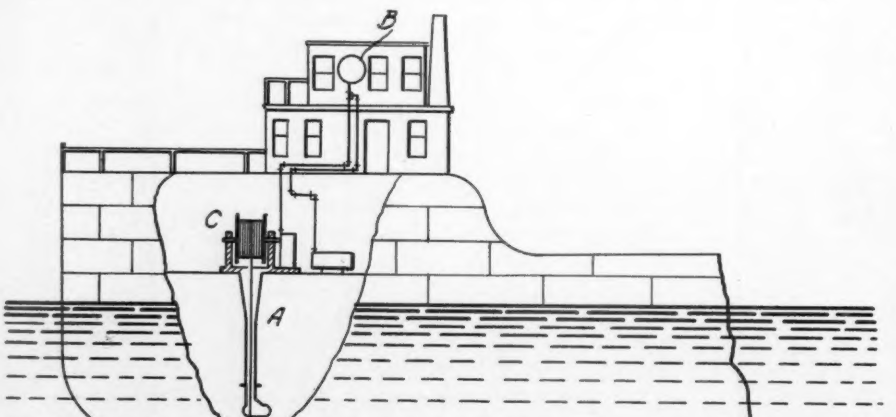
This armor is encased within a system of intertwined wire cables which, together with the other structural elements, give the sounding hose a tensile strength of approximately 70,000 pounds. Finally, to protect the finished cable from wear when being dragged along over a waterbed, the conduit is provided with a jacket made up of hard steel rings which are so arranged that they do not interfere with the flexibility of the hose. About 500 feet of hose is coiled on the winding drum.

The Haynes Automatic Sounding Machine may also serve as a speed-recording apparatus. This is understandable when it is realized that the sounding tube would not hang vertically if a steamer were underway but would trail off more or less obliquely—the depth of the nozzle varying with the speed of the craft. Therefore, with the hose hanging at a given depth, the pressure of the escaping air as registered in the charthouse would be a fairly close indication of the speed at which the boat was advancing. Thus, the equipment can be utilized not only to take soundings but to indicate the rate of movement through the water.

This ingenious safeguard to the mariner will keep watch continually, when once made ready for service, and it represents the climax of years of developmental work. At the present time, so it seems, there are 25 or more of these sounding machines in use on vessels of different kinds plying the rather hazardous waters of the Great Lakes; and two of these equipments have been placed on the big passenger liners, *Greater Detroit* and *Greater Buffalo*, operated by the well-known Detroit & Cleveland Navigation Company.



From right to left can be seen the steam engine which operates the hose reel in the center, and the air compressor, at right, which provides the counterbalancing air that is forced down through the hose when trailing.



General arrangement of the principal features of the Haynes automatic sounding machine: A, standpipe; B, registering instruments in charthouse; C, reel, compressor, etc.; and, D, the compressed air-filled sounding line or hose.

It is reported that this year's activity in the building trades will approximate and, perhaps, surpass the record figures of recent years. Contracts awarded during the first five months of the current year had a value of $2,119,564,100, which is nearly ten per cent. larger than the 1924 figure, and 22 per cent. higher than that of 1923.

COMPRESSED AIR WARNS OF RAMP OPENINGS

GUARDING open stairheads is always a difficult matter, but in the plant of one manufacturing company an especially aggravating case cropped up to spoil otherwise perfect accident-prevention records.

Buildings "A" and "B" had been erected at different times and with unequal floor levels—a covered alleyway between the two structures serving as an avenue for all inter-departmental trucking. The alleyway was on "A" level, with ramps leading down to the corresponding floor level in "B." To facilitate trucking, these ramps entered the alleyway at an angle of about 30 degrees, and with the doors into "A" placed at intervals midway between the ramp slopes.

Gates were out of the question on account of the hindrance they presented to traffic; and the use of red lights failed because the man pushing a heavily loaded truck traveled with his head down and could not, therefore, see the light until after he had passed the danger point. Guard rails of 2-inch timber were then bolted to the floor so as to swing the truck away from the ramp just before reaching the opening, but these caused collisions when two trucks chanced to meet at the openings.

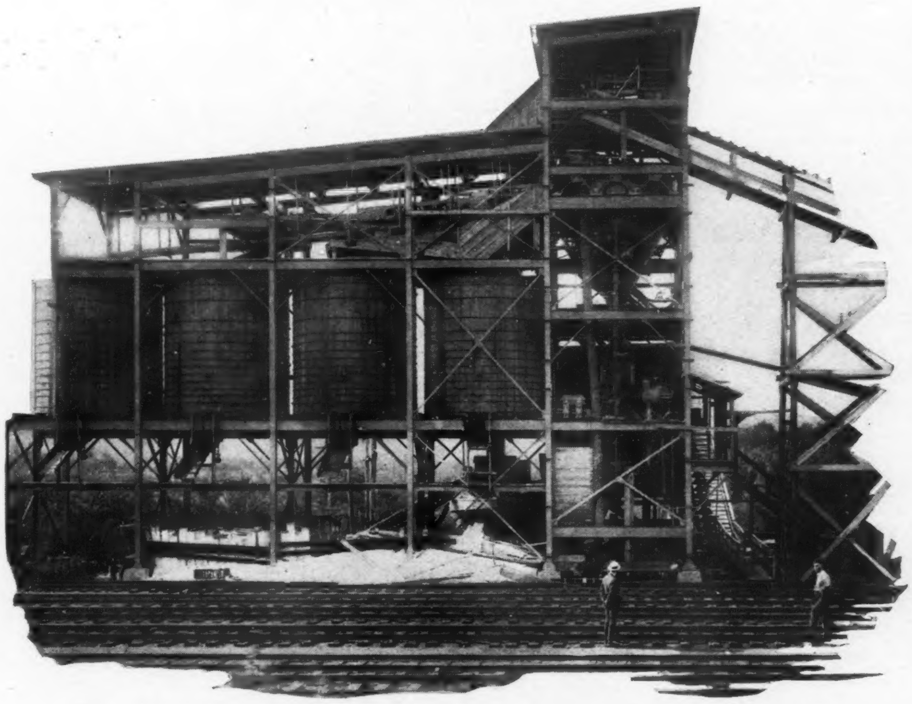
Small air lines were next installed, each capped about five feet from the floor with a minute air whistle; and these served admirably until the men began mimicking the whistles as signals to one another. Then, when one of the whistles happened to clog, a solution of the problem was accidentally found.

An 18-inch length of rubber tubing was slipped over the end of the pipe, bent sharply over, and the bend held with a rubber band to curb the escape of the air. The band broke and the waving hose suggested the remedy. A quarter-turn in the place of the whistle, and the hose, thus directed across the path of traffic writhed to and fro and presented a flexible yet positive guard. No matter how absent-minded a trucker might be, the blast of air or the light tap of the hose on his head warned him of the presence of the ramp opening, and, as a consequence, the source of accidents was nullified.

Alberta may become an important factor in the pickle industry. Experimental plots have been planted to cucumbers this year by farmers in the Lethbridge northern irrigation district, in an effort to determine whether or not this vegetable can be grown successfully and in large enough quantities to justify the establishment of a pickle plant in Taber or in the neighborhood.

How Anthracite is Mined in the Pennsylvania Coal Fields

By JAMES H. COLLINS



This anthracite breaker uses a flotation system for cleaning the coal.

YOU can mine ten tons of hard coal, but sell only nine—the other ton is burned up at the mine for hauling, hoisting, ventilating, pumping, heating and so forth.

To mine a ton of coal, it is often necessary to pump 30 tons of water.

The day of the mine mule is over—and it isn't. Electric locomotives now do most of the hauling; but when you want intelligence on the job—say to put cars on the hoist at the psychological moment—the old-fashioned "hay burner" is capable of thinking for you, and hence survives by his brain.

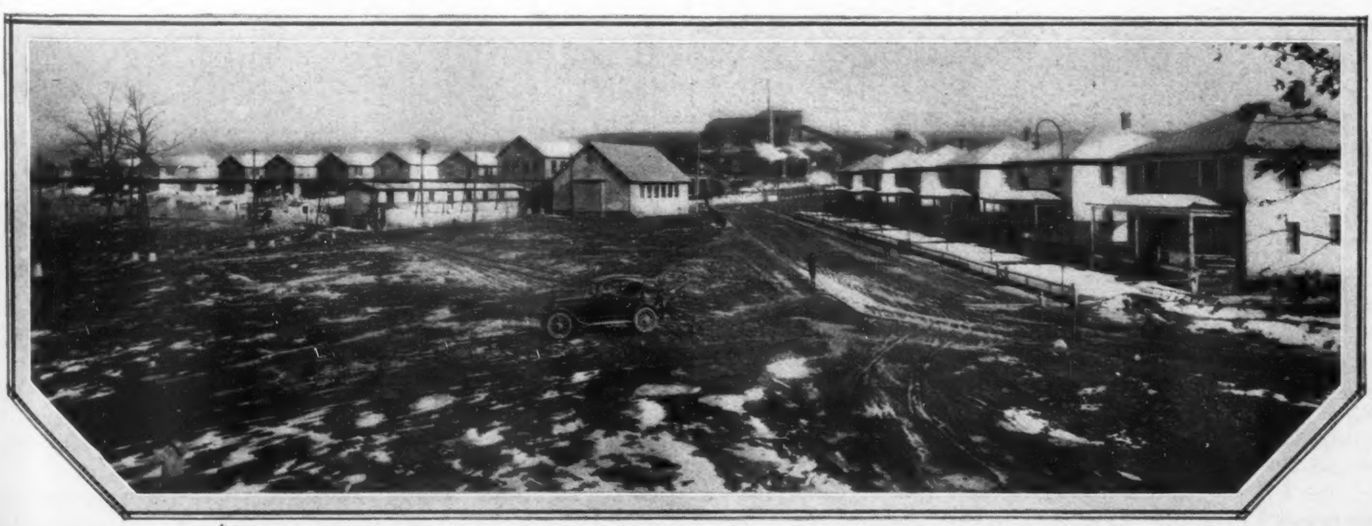
An anthracite mine is a great place for compressed air power.

In other days, when the coal veins were many feet thick, hand drills that bored holes like augers, for blasting, did the work. But today, without the improved "Jackhamer mining," it would be well-nigh impossible to take coal out of seams two feet or less in thickness. In the Diamond mine, beneath Scranton, Pa., that I visited the other day, they are constantly working about 300 of these machines, and getting out twice as much coal as would have been possible with the old hand drills. The important fact showed, I thought, how indispensable air power has become in mining—there is something like 30 miles of air mains in this mine to serve the drills, ranging from 6-inch pipe down to ¾-inch.

I don't know why, with all my industrial sight-seeing in the United States and other countries, I'd never seen a coal mine. Metal mines—yes! I've been under ground in the zinc-lead-silver country of Idaho, and have seen the steam shovels tearing down a Utah mountain in low-grade, open-cut copper mining. But coal—no! So, like a good many other greenhorns, I had a mental picture of a hole in the side of a hill, with a narrow-gage railroad track coming out, and a little car of coal hauled by a mule, driven by a boy, and being dumped right into a railroad car, all neatly graded into egg and chestnut. Which is not the way coal is mined at all—at least, not hard coal.

An old anthracite mine like the Diamond, which has been worked for 77 years, is a hole in the ground all right — and some hole! But it is also a complicated factory, because most of the work is done on the surface freeing the coal from refuse; breaking it up into market sizes; washing and grading it into egg, stove, chestnut, pea and buckwheat; and getting it on to the cars, despite the vigilance of several inspectors.

Underneath the surface of the city of Scranton, with its 150,000 population, there are about a dozen subterranean Scrantons, with a good many more streets and avenues. They say that eventually the mining companies will put back all the material in the unsightly culm and rock banks, pumping it into the old chambers and gangways to get it out of the way, and prevent surface settling.



The up-to-date operator in the anthracite field provides comfortable and attractive looking dwellings for the miners.

The Diamond property is a mile wide and four miles long. Superintendent T. L. Oliver spread out a working blue print of one level. It looked like a subterranean Scranton, with its tortuous avenues, side streets and alleys. That being one of the older levels, many of the underground blocks were crossed off, as abandoned.

The first thing I wanted to know was, how a dozen separate layers of coal—in no way connected with each other until miners sunk shafts to reach them—were laid down beneath Scranton in the first place. That made it necessary to look into the origin of coal, which is the proper place to begin to understand anthracite mining.

Way, way back, when you were a tadpole and I was a fish, a swamp existed here—a tropical swamp—with gigantic palms and tree ferns. The vegetation grew, died, fell, was replaced with new palms and tree ferns, and that went on for ages until, according to the best theories, the swamp was submerged beneath the sea. Perhaps by earthquake, or gradual settlement—nobody knows. It lay under the sea for more ages and was covered with a layer of silt and sand anywhere from a few feet to a hundred or more. Pressure, heat, and chemical changes began the transformation process into coal. This is an orderly growth, like the growth of a tree. First, there is the vegetation which turns into peat; then lignite; then soft coal; and, finally, hard coal, with some of the graphite minerals closely related.

At some time, when this process had started, there came another change in terra firma that heaved the land up again, making another swamp in which trees began to go for a second deposit of coal; and that was followed by another submersion, and silting, and upheaval, and so on, anywhere from one to two dozen times, to make the Pennsylvania anthracite field.

Terra firma! "Nothing, not even the wind that blows," said Darwin, "is so unstable as the level of the crust of this earth." Darwin was right!

You and the geologists figure out how much time this took—it makes my head swim!

Some of the Pennsylvania fields contain as many as 20 beds of anthracite. At Pottsville there are 28 individual beds with an aggregate thickness of 154 feet of coal.

Nature made the stuff and then began wasting it. For the three Pennsylvania anthracite beds that constitute all our hard coal, known as the Northern, Middle, and Southern (Scranton is in the Northern field), there is but a small part of the original deposit. Geological evidence shows that billions upon billions of tons were eroded and swept away into the sea by the glaciers in the one or more ice ages that have occurred in this part of the United States since the coal was laid down, which is just like Nature! As a western friend of mine once said, "If Nature didn't have so much material, she'd have a darned hard time making a living."

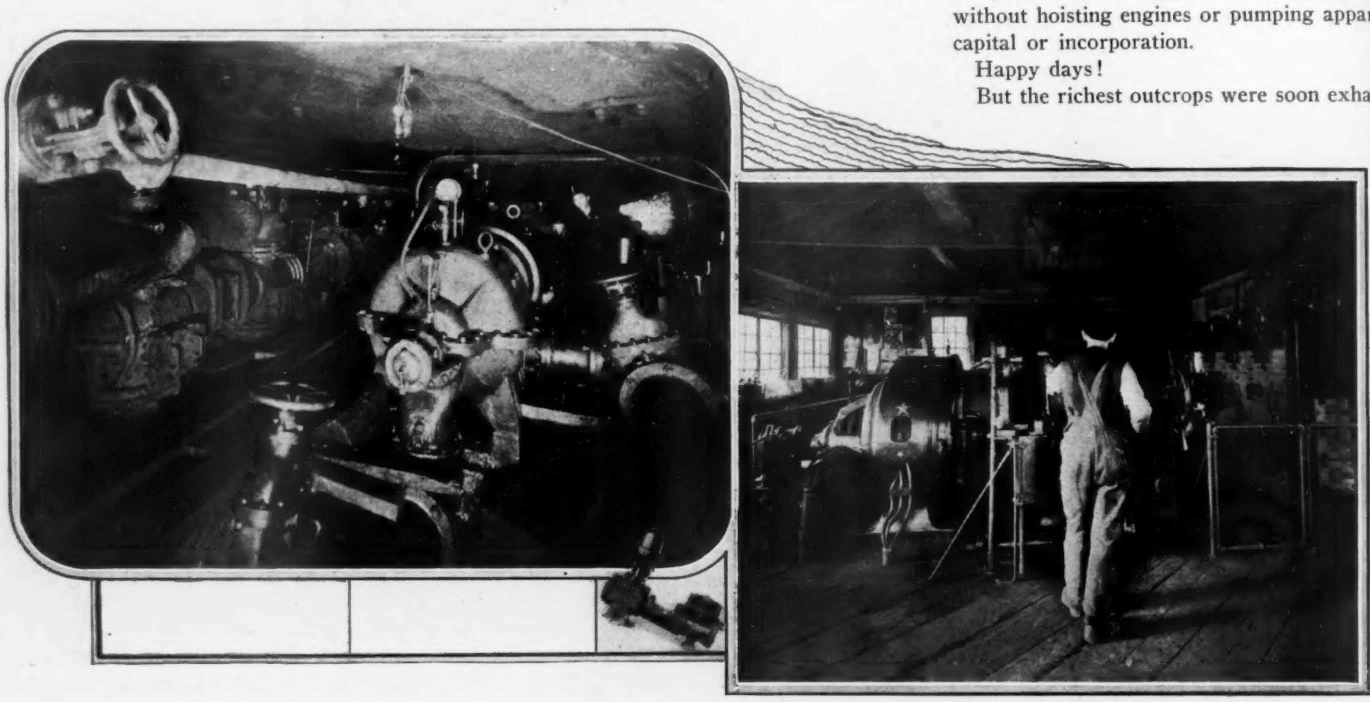
Maybe Nature ran out of glaciers, or intended to get the rest of the anthracite during her next ice age. But along came man—first the Indians, who learned that there was a black stone in these mountains that would burn—and then the white man, who, as early as the late seventeen hundreds, when the early settlers came into the Wyoming valley, foresaw value in this stone. There are deeds preserving coal rights dating back as early as 1801. For a hundred years, there was no necessity for burning coal in a country so thickly forested that trees were the farmer's worst obstacle. And when people tried to burn anthracite it wouldn't kindle. But somebody found that it burnt readily enough if started on a bed of wood coals, and in 1808, in a Wilkes-Barre tavern, Judge Jesse Fell demonstrated that anthracite would burn in an open grate. On February 11, 1908, this demonstration was celebrated as the official centenary of hard coal.

There is one vein near Plymouth, in the Northern field, known as the "Wheelbarrow Drift" which has been worked for nearly one hundred years.

The name is significant, for the first anthracite mining was done at the outcrop, in the side of a hill, where the coal had been cut by glaciers, and could be broken off with picks and trundled away in a wheelbarrow. They tackled the biggest veins single-handed, without hoisting engines or pumping apparatus, capital or incorporation.

Happy days!

But the richest outcrops were soon exhausted by tunneling and "stripping"—the latter consisted of removing the earth from thick veins near the surface, and digging the coal out as from a ditch. And it is said that nothing was allowed to stand in the way of a stripping operation.

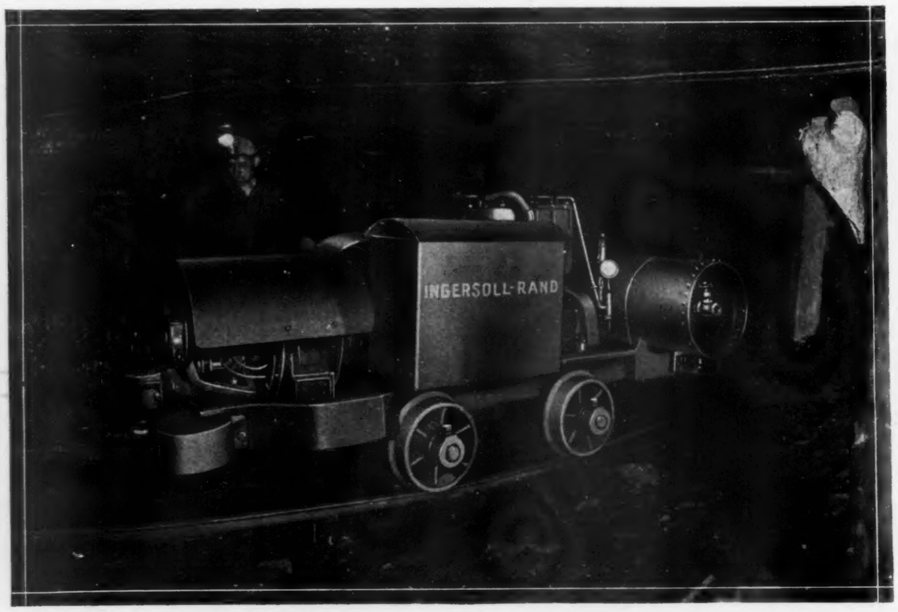


Above is pictured part of an underground pump room in a large anthracite mine. These pumps are capable of handling rapidly large volumes of water either continually or from time to time, as conditions require.
At the right is a hoist room at a coal mine. The hoisting engineer has a very responsible job, and upon his skill depend the safe travel of coal surfaceward, and the carriage of miners and essential equipment up and down the shafts.

Eventually, it was necessary to sink shafts straight down, cutting through the various veins and taking out coal from the thickest ones by hoisting—the method that is practically the only one in use today. This calls for machinery, money, and engineering. People who put their money into coal companies wanted profit. The cry was for heavy tonnage, and the thick veins were mined first, leaving the thinner ones to the present generation—and with them many problems. The thinner the vein got, the more engineering skill was needed and the more money.

The experts do not seem to agree about how much anthracite we have left, some predicting that it will be exhausted in 50 years, and

Fig. 1—Miners equipped with gas masks, safety lamps, etc., inspecting an abandoned working where the air is foul.
Fig. 2—Using "Leyner" drifters in driving a 7x10-foot tunnel in an anthracite coal mine.
Fig. 3—Miners squaring a tunnel in an anthracite mine with Ingersoll-Rand "Jackhamers."
Fig. 4—Drilling blast holes in an anthracite seam with a BBR-13 "Jackhamer" equipped with auger steel.
Fig. 5—Attacking a seam of anthracite with a BCR-430 "Jackhamer."



The portable mine car compressor has greatly simplified the problem of quickly delivering compressed air anywhere within a coal mine.

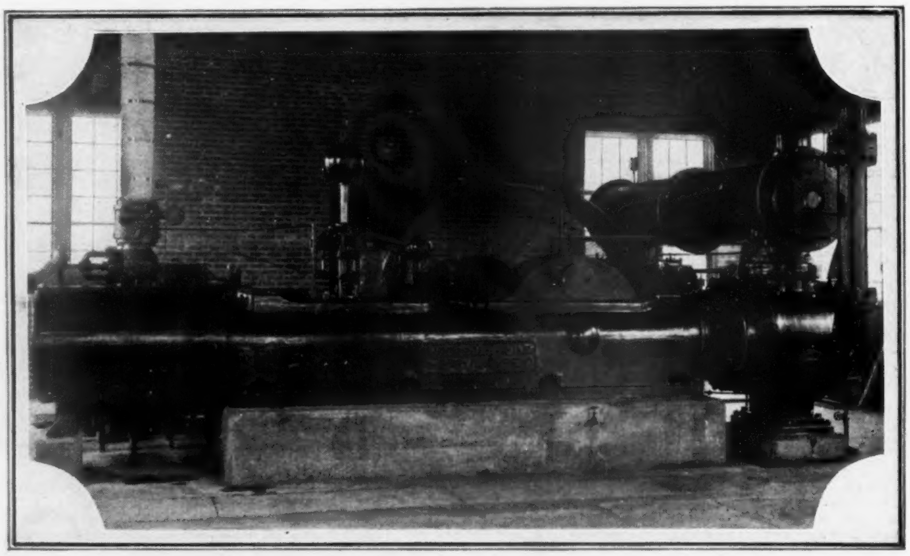
others maintaining there is enough for a couple of centuries. The truth is, probably, that we have enough to keep miners busy for at least two or three generations. But the cream has been skimmed in many mines, and the remaining coal is in thin veins, calling for ingenuity in mining—ingenuity and money in such amount that it is big business.

To get coal out of a vein with less height from bottom to top than your desk was considered impossible a few years ago. Today, it is not only taken out clean, but in percentages of market sizes that would have been considered phenomenal a generation ago. In anthracite, you know, all sizes from pea down are practically wasted, because apart from a very limited steam use, the market is among householders and they want the larger sizes.

Getting the coal out in good-size pieces is a matter of carefully placing shots, and the use of slow explosives that push the coal out without scattering it. And cleaning out the thin veins is a matter of compressed air and small drilling machines.

To get at the thin veins, a gangway is driven at right angles, opening up the face. Such gangways are driven at intervals of about one hundred to several hundred feet apart. They must be at least six feet high, and wide enough for mine cars, with three feet additional on one side to allow miners to step out of the way—that is law. From these gangways, the miners work into the seam, keeping as close to its width as possible. Obviously, this calls for compact tools and much work in a crouching position. Scrapers attached to wire rope are placed so that coal, when blasted down, can be windlassed out where shoveling would be impossible.

They claim that working conditions in the Pennsylvania anthracite coal mines are the best of any in the world today. Ventilation is generally good, overhead space in most cases good, the hours short, and most coal miners live in town where they have theaters, churches, schools, and so forth. The element of risk has been reduced to a minimum by law, state inspection, and the licensing of miners.


This XPV-3 compressor is capable of delivering 3,026 cubic feet of free air per minute at pressures ranging from 80 to 110 pounds.

Getting good haulage ways to take coal out of a mine 50 years old is a serious problem. So is ventilation, and so is pumping.

In working underground, miners not only cut into springs and subterranean streams, but occasionally tap a surface lake, or even a river. If it is a big thing like a river, it may be necessary to divert it until the leak can be plugged up, and then let it resume its original right-of-way. This rather tickled me—the idea of an engineering traffic cop saying "stop" and "go" to a river! This isn't always necessary. Sometimes the hole can be plugged with sand or silt.

However, these are exceptional cases. The great volume of water encountered in mines is a regular aggregate from small streams that cannot be stopped. So pumping out from 10 to 30 tons of water for each ton of coal is all in the day's work. A separate article could be written about mine pumping. The water is charged with corrosives, so pumps must be proof against that. There is a great deal of grit in mine water to grind pumps to pieces — pumping engineers prevent this by freeing the water of its sediment before it reaches the pumps; with baffles, by keeping the water courses clean, and other methods. Mine pumping equipment nowadays will lift a ton of water a couple of hundred feet for two cents! Frequently, in sections where steam or electric current is not available, small pumps are connected to the compressed air line to lift water.

As a rule, the Pennsylvania anthracite measures lie flat, or to some extent follow the contour of the surface. Occasionally, seams rise to steep pitch, complicating the difficulties of getting out coal, but fortunately level seams are the rule—the anthracite miner has plenty of trouble otherwise.

The coal comes out of the mine in little gondola cars holding three tons. Below ground these are hauled in trains by electric locomotives. As I said, the old "hay burner" has pretty much lost his job. Power for the electric locomotive is supplied by a trolley wire. Sometimes the coal goes directly on the hoist and is briskly lifted to the surface, a car at a time, by elevator, and dumped into a conveyer that lifts it to the top of the breaker. In other cases, coal actually comes out of the side of a hill in the train of cars hauled by an electric mule.

The first place one ought to visit after coming out of a mine is the "Court House."

Each car of coal is credited to an individual miner, who is allowed so much rock and bone as inavoidable in the cleanest mining. I think they said three hundred pounds per car—that's 5 per cent, isn't it? If an inspector finds that a miner has exceeded this, his car goes to the court house, which is simply a siding where an inspector sorts the coal by hand, weighing the refuse.

"That car he's working on now will run seven hundred pounds," said the superintendent, "and the man who sent it up will be laid off so many days, as a penalty."

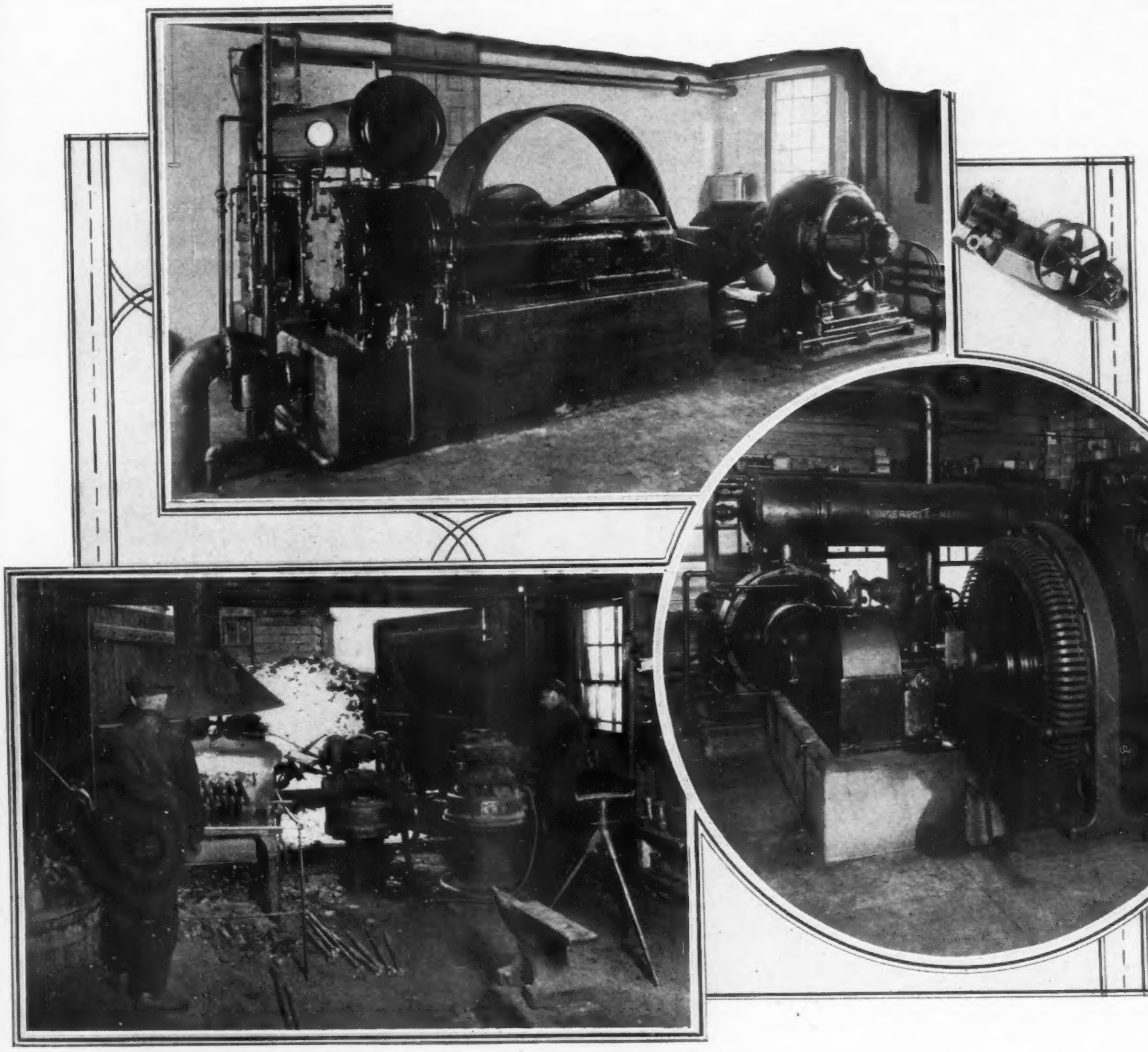
If the mine car load passes directly to the

breaker, it enters the factory end of anthracite mining.

Every passenger who has ridden through Pennsylvania knows what a coal breaker looks like—a structure towering a hundred or more feet in the air, built of wood if it is old, and steel or concrete if it is new. As in many other factories—particularly flour mills—the rock dump. It requires considerable judgment to tell boney from coal, for what the novices might pick out as coal would be black and shiny, but unburnable, whereas an experienced sorter will allow what looks like bone to pass, because he knows it has a high carbon content.

Then, next, the breaker proper. This used type, on a slightly inclined plane, and sorts the coal without tumbling it about.

From there to the separator, which separates coal from rock. A good many large pieces of coal passed by the pickers contain considerable rock, which can be separated after the lump has been broken up. Here the wet part of the breaker begins. Up to now, the



The top and the circular pictures illustrate two types of electrically driven compressors, each of which is capable of supplying a large volume of air at a working pressure ranging from 80 to 100 pounds. Compressed air is used extensively in and about an anthracite coal mine. The bottom picture was taken in a colliery blacksmith shop which is equipped with an Ingersoll-Rand coke forge and Nos. 5 and 50 "Leyner" sharpeners.

coal is first taken to the top by conveyers and works its way down to the bottom, by gravity, through the various processes of sorting, breaking, cleaning, and grading.

In other days, a coal breaker required hundreds of small boys, and the "breaker boy" was the pitiful child-exploitation figure of his day. But like the mine mule, he is gone. A dozen lads at the very bottom of the breaker, giving a final once-over to the coal, are now sufficient.

At the top, the coal passes before men sorters on slow-moving endless belts. It is of every conceivable size, from great hunks to dust. These men pick out the rock, bone, pyrites and other refuse, which go out to the to contain a series of cast iron rolls with blunt teeth, running at slow speeds, that ground much of the coal to unmarketable dust. But the modern breaker comprises some of the greater improvements in mining machinery. The rolls have pointed steel teeth running at low speeds that break the coal without crushing it. The old breaker sometimes wasted 25 per cent. If the new ones waste 5 per cent., the superintendent is right on the job.

After that, the screen for sorting into different market sizes, and here, too, there has been great improvement. Old-fashioned screens were of the revolving type and broke up a good deal of the coal as well as wasted power by friction. The present-day screen is a shaker coal has been handled dry, but with surprisingly little dust. In the separator coal is given a bath and moved up and down in water, and as there is a difference in specific gravity between coal and rock, the former passes out at the top of the separator, and the rock below.

Next, the wet coal passes before the breaker boys who give it the final inspection, and is then loaded on cars for the market. Incidentally, an inspector keeps a sharp eye on it to make sure there is not too much buckwheat in the pea, or pea in the chestnut.

There is a good deal of other surface plant worth visiting for anthracite mine's work is done above ground as much as possible. The power plant is a busy place, with its boilers

for supplying steam, its air compressors sending power down to the drills, and its dynamo for the electric hauling apparatus. The visitor is sure to be interested in the hoisting engineer, who sits with his levers on either hand, and his eyes fixed upon clock-like indicators that tell exactly where each of the two hoisting cars are in their dark shafts. A bell rings, he moves a lever, and one of the cars shoots to the surface at high speed, stopping within an inch or two of the dump. It used to be a mine joke to drop visitors at coal speed instead of the half-speed at which men are lowered into the mine, but that's out—the "Safety First" movement put an end to it.

The mine has its lungs in the great ventilating fan and blowers, and their efficiency is demonstrated in the marked decrease of gas accidents. In early days, mines were ventilated only by natural currents of air, or with a furnace at the foot of the shaft to generate an air current. As the workings went deeper, ventilation did not keep pace, and there were accidents not only from explosions and gassing, but poor ventilation caused asthma and tuberculosis. Nowadays, this is all regulated by state law, governed by inspection, and the science of ventilation, plus large scale ventilating apparatus, makes the mine safe, healthy, and comfortable to work in. Given good air, a mine has an attractive climate, with a mean temperature of about 60 degrees F. all year round—a summer resort in winter, a winter resort in summer. A large ventilating system will move a quarter million cubic feet of air a minute, taking out not only all possible gas, but the considerable volume of smoke and fumes arising from blasting operations.

If you have ever pondered a locker room problem, the wash house at the head of the shaft may suggest something useful.

An anthracite miner doesn't exactly come to work in a Tuxedo, or in his limousine—not yet! But he does wear to work clothes so good that you might not recognize him as a miner. At the wash house he changes to working clothes; and his street togs, instead of being locked away in a steel compartment, are hauled up fifteen feet from the floor with a wire rope and fastened with a padlock, which only his key will fit. There his clothes are out of reach of pilferers, and get well ventilated. When he comes out of the mine in dirty damp clothes, these are swung aloft and soon dry out. Before changing into street clothes he has either a hot or cold shower in a spacious washroom—even a tiled washroom if it is of recent construction. So far as I could see, office and factory workers have no advantage over the anthracite miner in such respects, and he has decided advantages over most of them in wages and regulated working conditions.

If anybody ever invites you to visit an anthracite mine, by all means go!

The Osgood Company, Marion, Ohio, has recently issued Bulletin 256 which contains much unusual information about Osgood Power Shovels that can be operated by gasoline, by oil, or by electricity.

FINER GRINDING INCREASES STRENGTH OF CONCRETE

ABOUT ten years ago the U. S. Bureau of Standards began an investigation to determine the effect of fine grinding of cement on the strength of concrete. Other investigators took up the subject and studied this effect for short periods of time, usually one year. It is felt, so a bulletin from Washington announces, that the Bureau's tests should be of especial value because they extend over a whole decade, and show the effect of fine grinding on the strength of concrete at definite intervals during this period.

For the investigation five commercial brands of cement, as received direct from the manufacturers and representatives of their marketable product, were used. Each cement as it was received was thoroughly mixed and divided into two lots. One lot was used as received for making concrete, while the other was ground in a ball mill for one and one-half hours before use.

Concrete cylinders 8x16 inches were made from both lots of cement, Potomac River sand and gravel being used as the aggregate. The materials were proportioned either 1:2:4 or 1:3:6 by volume. After remaining in the molds for 24 hours the specimens were stored in moist air for 28 days. After the 28 days' curing the specimens were placed out of doors exposed to Washington weather conditions until broken. Compressive tests were made at the 7-day, 28-day, 6-month, 1-2-3-5 and 10-year periods. The extreme variation in fineness in the two lots of any one cement was 20.1 per cent. on the standard No. 200 cement sieve.

From the results of these tests the following conclusions may be drawn. No retrogression is shown in the compressive strength of the concretes at the end of the 10-year period. In general, the fineness of the cement increased the strength of the concrete. All cements do not give the same increase in strength with the same increase in fineness. The effect of fineness of cement on the strength of concrete diminishes with age. The 1:2:4 mixes show better increases of strength with the same increase in fineness than do the 1:3:6 mixes.

At the plant of a motor company in Oakland, California, metal drums are used in which to coil compressed air hose so that the hose can be kept off the floor as much as possible. When the hose is needed to furnish air to a riveting hammer or any other pneumatic tool, which is to be used some feet away from the drum, it is an easy matter to quickly uncoil the hose and to carry it to the point desired.

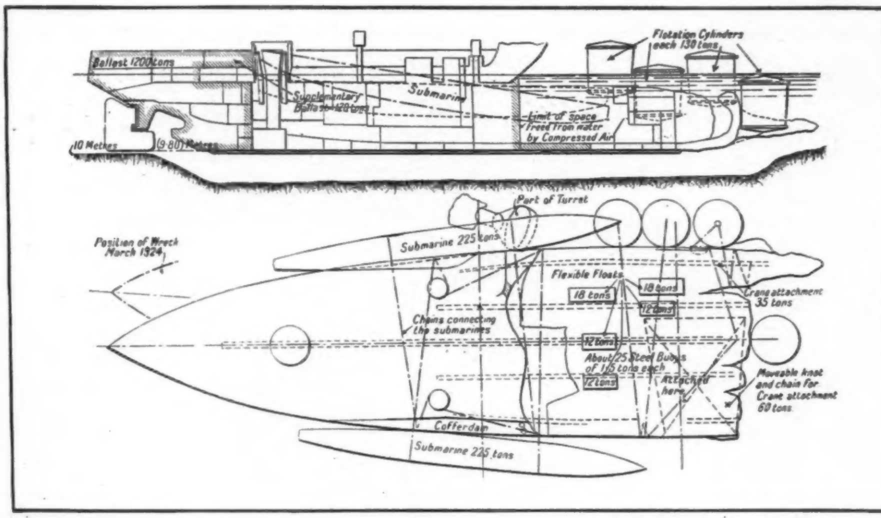
THE WEIGHT OF THE CARRIER

TRANSPORTATION problems are numerous and various, and their solutions are never final but develop as we advance. One of the most interesting and important of these is that of the dead weight of the vehicle as compared with that of the load carried. We can easily comprehend this as related to the airplane, but it is very interesting also when land transportation is considered, and astonishing discrepancies are here disclosed. Motor buses are now built and operated, it is said, with a total dead weight below 300 lbs. per passenger. Automobiles cannot make as good a showing as this, the minimum claimed for a five-passenger car being 360 lbs. per person, while some machines go to double that figure. The lead from these figures, however, to those of steam railroad practice is quite startling. A standard passenger coach has a weight of 1,900 lbs. per passenger, while a Pullman parlor car shows 5,900 lbs. per seat, these figures not including, as in our comparison they should, the weight of the locomotive. These weights figure not only in first costs but also in cost of operating, or in the power required for the propulsion of the masses over the road. The handicap of the railroad in competition with the bus is sufficiently evident.

Compressed Air Aids in Refloating "Liberte"

By J. CRAPAUD

FOURTEEN years ago, on the 25th of September, nearly half of the great French battleship *Liberté* was destroyed or hopelessly wrecked by the spontaneous ignition of smokeless powder in one of the magazines situated aft on the starboard side of the craft. Substantially 8,000 tons of steel was instantly blown into a tangled mass that curled back on itself, and hundreds of lives were snuffed out while the great ship lay seemingly secure at her mooring buoy in the harbor of Toulon.



Courtesy, The Engineer.

Diagram indicating the various ways in which compressed air was utilized in refloating and righting the French battleship Liberte.

For years thereafter the wreck was a menace to navigation, and efforts to remove the obstruction were halted by the more serious problems incident to the World War. Not until the early months of the present year were the French naval engineers able to refloat the remaining section of the ship and to carry it into the basin of the Toulon Arsenal to undergo scrapping. The various aspects of this monumental task have been described at length in an issue of *Le Génie Civil*.

In the course of its long period of submergence, the wreck settled deeply into the mud, and a considerable part of the task of the salvors consisted in breaking this contact and freeing the hulk so it could be lifted and towed away. Compressed air was employed to good effect in releasing the wreck from the grip of the surrounding mud. Indeed, but for the use of compressed air in various ways it would have been next to impossible to have removed the wreck as a whole by refloating it.

An old cruiser was placed alongside the submerged hull and equipped to serve as a floating base of operations. On it were first placed four sizable air compressors, and later on two more compressors were added. Compressed air was applied both inside and outside the wreck to raise it and to right it so that it could be moved to the Arsenal for cutting up. Externally, the compressed air was made effective through the agencies of floating cylinders, flexible floats which could be inflated, and a couple of old submarines, each capable of exerting, when immersed, a buoyant effort equivalent to 225 tons. The manner in which these several agencies were brought into play is clearly indicated by an accompanying line drawing reproduced from the well-known English technical weekly, *The Engineer*.

The execution of this salvage task called for months of persistent and in many ways perilous work to get the wreck ready for the final efforts that freed her from the harbor bottom and placed her in a condition to be handled by the tug boats. The tangled steel work had to be threaded by courageous divers who took their lives in their hands at nearly every step. Bulkheads and cofferdams had to be built under water and in the face of extremely hampering conditions. However, the work was skilfully done and carried out with the utmost care so that the final applications of compressed air did all that they were expected to do. It is probably correct to say that much of the procedure was based upon previous performances and practices developed by certain American maritime wreckers who have specialized in the utilization of compressed air.

Manner in which the Liberte was righted and refloated by means of compressed air.

Wreck as it appeared before salvage work started.

Marl Moved Nearly Two Miles by Compressed Air

By GEORGE F. PAUL

THE laying of a pipe line nearly two miles in length proved the successful solution of a problem that faced the officials of the Peninsular Portland Cement Company. The operation of their plant at Cement City, thirteen miles southeast of Jackson, Mich., depended on having an adequate supply of marl to furnish the calcium carbonate constituent required for the raw mix. In this emergency the services of the Cowham Engineering Company, of Chicago, were enlisted; and it was on their recommendation that the unique plan of bringing the marl by pipe line from Silver Lake was decided upon.

This system was selected after other methods had been rejected. Between the plant and Silver Lake there are swamps and rather high elevations. Pumping was out of the question; pump manufacturers refused to guarantee satisfactory performance. Then the building of an industrial railway was carefully considered and turned down on account of the great expense incident to constructing and operating such a line. The final decision was to bring the marl over by means of a pipe line, using compressed air as the impulse medium.

Part of the 10,000-foot pipe line through which marl is forced by compressed air to the plant in the distance.

An installation of this magnitude was such a novelty that it was necessary to do considerable investigating before starting the work. Many points had to be considered in order that the success of the system, when completed, might be insured. The engineers had to get data on compressors and return-air transporting systems. Such great quantities of marl were to be handled and such distances had to be covered that the manufacturers of equipment were not keen about guaranteeing results. However, the decision was reached to go ahead and install a compressed air system, using as an added safeguard a booster tank. This was installed at the first relay station to furnish additional air pressure to the pipe line after the material had left the receiver tanks. As a matter of fact, this safeguard was really not required, for after operations were under way no difficulty was experienced in pumping the material the entire stretch between the first and second relay stations.

There is a distance of nearly 10,000 feet from the lake to the mill. The first relay was established at a convenient spot about 1,700 feet from Silver Lake. This arrangement gave the pumping machinery on the scow the lightest duty at the start, and it also afforded an opportunity to add line as the scene of operations shifted to a greater distance. From the first to the second relay is 4,400 feet, and from the second relay to the plant is nearly 4,000 feet. For each relay system there have been provided a concrete receiving vat 18x20x7 feet deep, a compressor, and a pumping equipment.

The air pressure varies from 75 to 90 pounds. This has proved ample to transport the marl slurry over the longest link, or a distance of 4,400 feet, with a difference of 30 feet in elevation. For this line a special, spiral-riveted pipe is used. To insure tight joints over unequal surfaces, flexible joints have been employed. This joint is convenient for carrying the line around curves and over hills, because it permits a variation of several degrees in a single joint. Rubber gaskets are used to seal the joints.

The dredge is equipped with a 40-H.P. boiler and a two-drum engine; a boom that revolves in a half circle; and an orange-peel bucket. The bucket dumps into the hopper which is above the separator. A powerful stream of water is supplied, and through the action of the revolving paddles and the screw of the separator the marl is forced through a screen. Roots, vegetable growths, pebbles, and other obstructions are caught by this screen. The marl passes to a storage vat where it is kept in constant agitation.

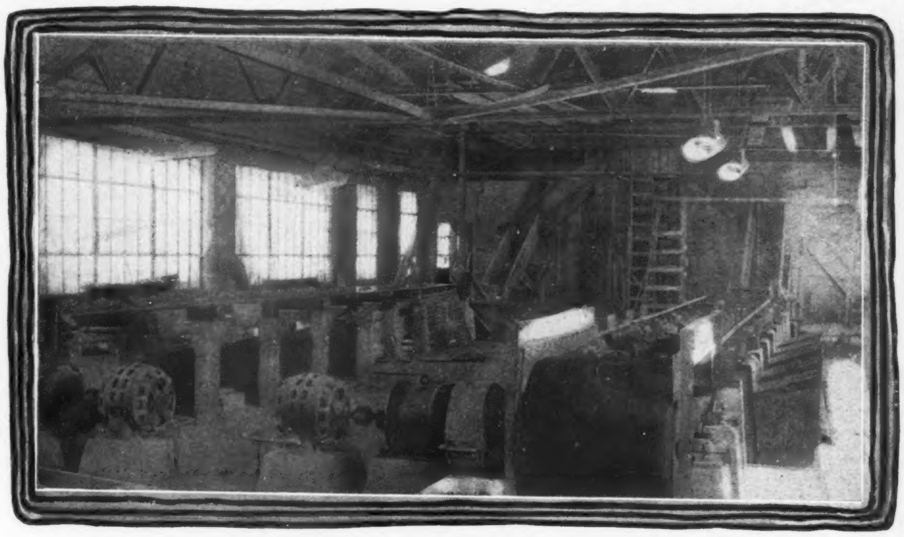
The most ingenious feature of the layout is the return-air system, provided by the Ingersoll-Rand Company. A 75-H.P. motor furnishes the power required for the air compressor. Two circular steel tanks, 5 feet in diameter, and 5 feet high, are located next to the storage vat. An automatic switch connects them with the receiver and compressor. Through the operation of this switch, one of the tanks is being filled while the other tank is being emptied. The switch trips automatically when the determined operating pressure is reached. This automatic feature has worked satisfactorily in every respect. With this equipment it has been found possible to operate beyond the prescribed requirements.

The dredging plant which draws up the marl and discharges it into the pipe line seen in the lower corner of the picture.

Big Silver-Lead Producer in Idaho

The Hecla Mine at Burke Presents Many Points of Interest

By WALTER E. CARR



Ore sorting plant.

A SHORT history of the Hecla Mine at Burke, Idaho, should be of interest, especially to those familiar with mining and who know the ins-and-outs of handling a large producer of minerals.

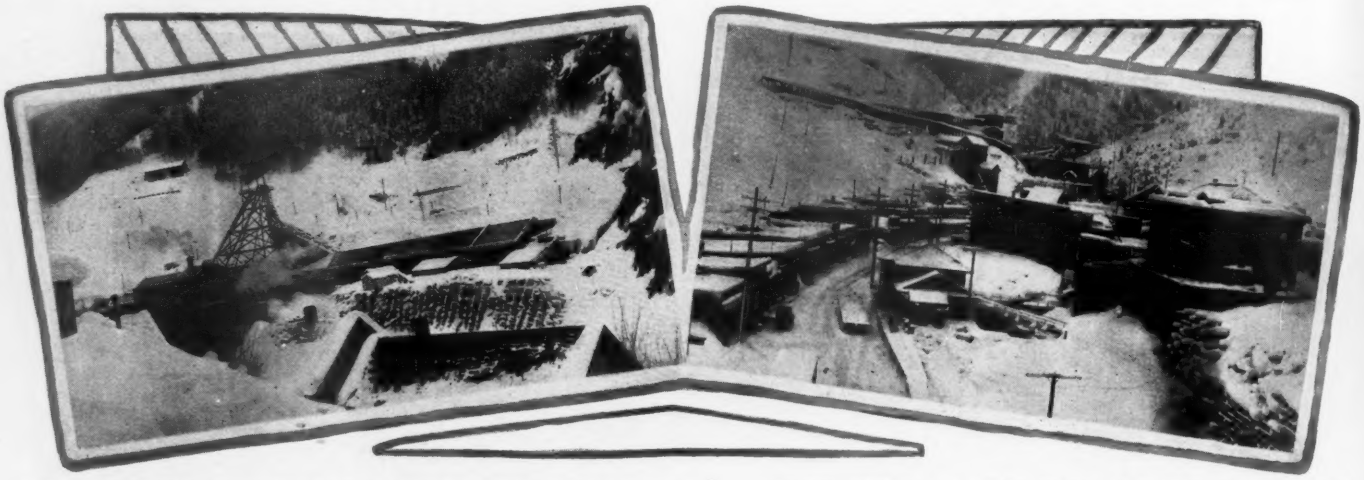
On Friday, the 13th day of July, 1923, the town of Burke was completely destroyed by fire, and the buildings of the Hecla Mine, situated in that town, were a total loss with one exception. This single exception was a large concrete and steel building that had been completed only a short time previously and in which were housed the fire pump, the heating plant, and an electric shop. After the smoke cleared away, this structure was found standing despite a severe roasting, thus proving conclusively its fire-resisting character.

Today, on the very ground where ruins for the most part remained when the flames died out, there now stands one of the most complete and up-to-date mine plants in existence. Every building is of concrete reinforced with steel—the one exception being the office, which is of brick with a fire-proof roof. The mine buildings generally are roofed with galvanized, corrugated iron, or with a roofing material composed of asbestos and cement. The latter material resembles the iron roofing, but is superior to the metal because it does not sweat nor drip moisture. It is, therefore, used on the power house in which are placed motive equipment and other mechanical facilities essential to the operation of the mine.

At the time of the fire, approximately 900 tons of ore was coming out of the shaft daily. It was necessary after the fire to install new compressors and to rebuild the hoist, to provide an extra pump to unwater the mines, to outfit a new machine shop, a new blacksmith shop, install new electrical equipment, etc., before operations could be resumed. In addition to the new reinforced concrete buildings referred to, the management was obliged to erect a new steel head-frame 134 feet high to replace the wooden one that was destroyed. Notwithstanding all that had to be done to make ready for work again, still by the 27th of January, ore was coming out once more from the Hecla shaft; and in the course of 1924 a total of 246,209 tons of ore was mined, from which was produced 38,280,735 pounds of lead and 1,093,861 ounces of silver.

The mine is equipped with two Ingersoll-Rand "PRE-2" compressors, one having a piston displacement of 5,576 cubic feet and the other having a piston displacement of 2,033 cubic feet per minute. Leyner-Ingersoll No.

Compressors which furnish the operating air at the Hecla Mine.



Left—How Hecla appears when viewed looking up the canyon. Right—Picture of Hecla taken from the sorting plant.

248 drifters, CCW-11 stopers, DCR-23 "Jackhamers" for shaft sinking, and DCRW-23 mounted "Jackhamers," for light drifting, are employed underground.

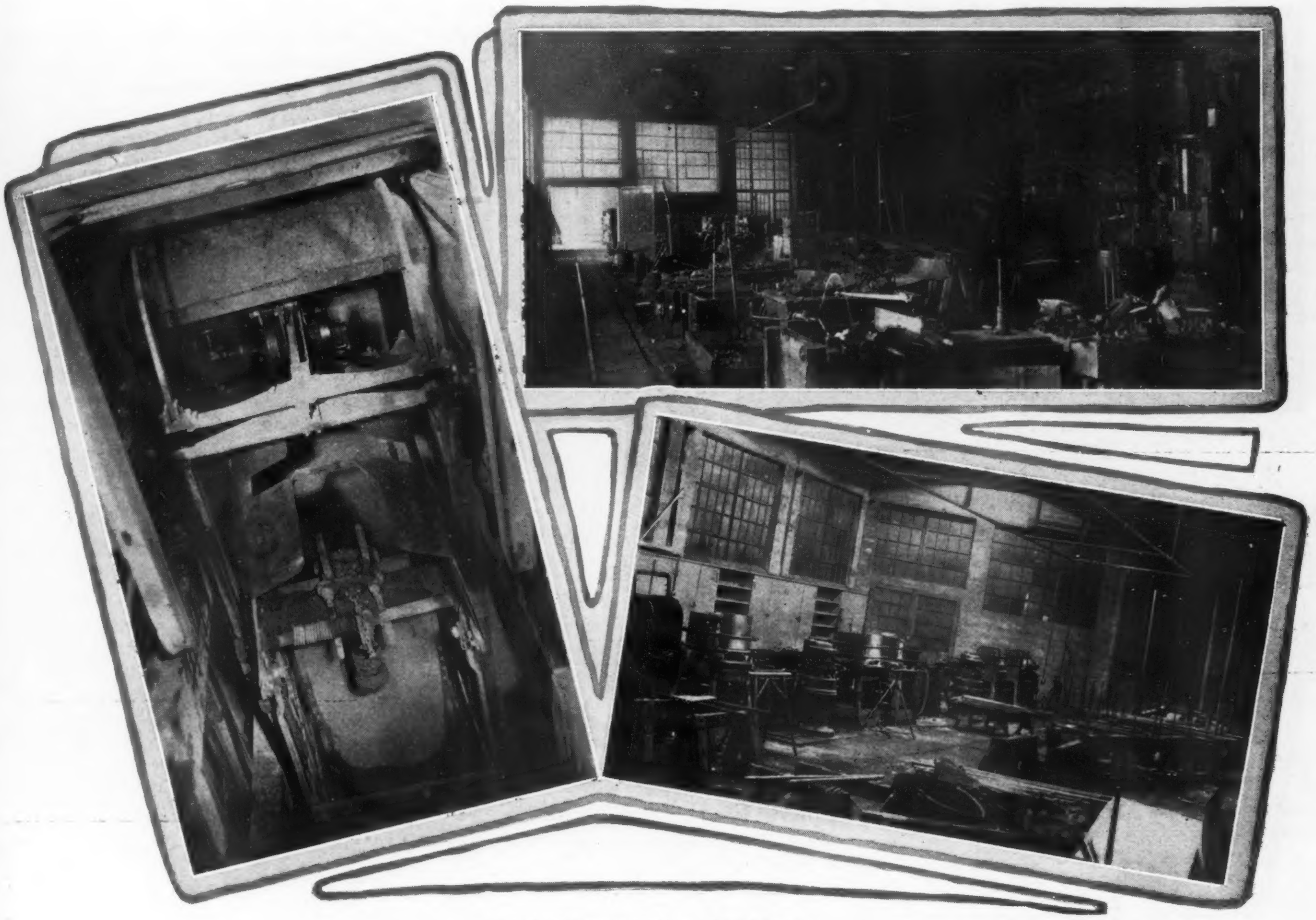
Cameron centrifugal pumps are relied upon to raise the mine water to the ground surface against a total head of 2,050 feet. At the 2,000-foot level there are three pumping units, each capable of handling 500 gallons per minute against a combined head of 800 feet—raising the water to the 1,200-foot level. On the 1,200-foot level there are three pumping units capable of pumping 600 gallons per minute against an aggregate head of 1,250 feet. The pumps on the 2,000-foot level are connected to squirrel-cage motors of 200 H. P., making 1,800 revolutions a minute. The pumps on the 1,200-foot level are arranged in three units—two Cameron pumps, in series, in each unit, driven by a 300-H. P. motor placed between each pair of pumps.

In the blacksmith shop there are three No. 50 "Leyner" sharpeners, equipped with "HLP" punches. On an average 600 bits are sharpened in the course of an eight-hour day. Four-point bits are used in drifting, stoping, and raise work, while Carr bits are used in shaft sinking. A very substantial saving is effected by employing Carr bits for this work. These bits cut faster in a hole that is pointed downward, and the hole can be cleaned much better and much time saved owing to the fact that the bits can be readily removed from the hole. Four men do the sharpening; and the average cost per bit is 4¾ cents. Triangular steel racks (Fig. 1) are placed within easy reach of the sharpener operators; and the top surfaces of these racks are covered with heavy flat iron. Iron uprights are so arranged that the various lengths of steel can be kept segregated as they are brought from the shaft. The resharpened steel is placed on steel trucks equipped with flat tired wheels; and these trucks are moved from place to place over the shop floor. One man does the hardening, and as the steel is resharpened it is put on the trucks and moved to the furnace for reheating and hardening. After hardening, the steel is carried to the racks which are stood upright against the wall of the building. Cars can be run into the shop on a track laid near the steel stalls so that the steel can be easily loaded upon cars and returned to the mine.

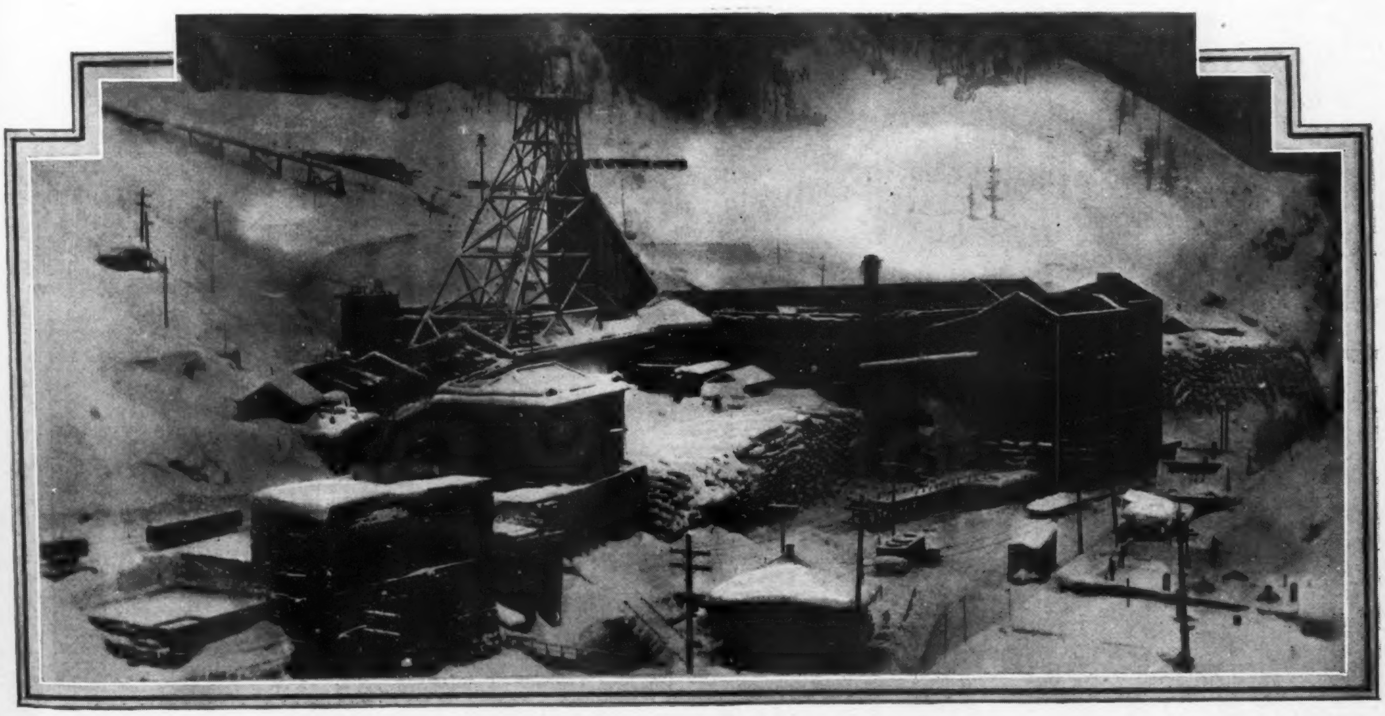
"Little Tugger" hoists are utilized for various kinds of work both underground and on the surface. A novel and efficient manner of changing cages is used in the double compartment shaft. Two "Little Tugger" hoists are arranged with a toothed drum—one for each compartment, and the drums are made of steel specially for the purpose. Instead of using rope on the drum, the circumference of the drum is cut to look like the teeth of a gear. A toothed rack engages these teeth. One end of this rack is forked, and the end of each point of the fork engages a swinging section of the guide on each side of the shaft. To hold these sections in place in the shaft so that they cannot move except when necessary to change a cage, the drum is locked, and the toothed rack is held tightly in the toothed drum. The forked end being fastened to each swinging section of the guides, the swinging sections are held firmly in place by the toothed rack when the latter is locked. The cage pits are arranged with stationary guides of sufficient length to communicate with the ends of the swinging guides, and accommodate the cages or skips when these are moved out of the shaft.

When the cage is to be changed, the cage in the shaft is stopped so that it rests on the swinging guides. The lock is unfastened on the "Little Tugger" hoist. Then the air is applied to the hoist and the drum starts, the toothed rack being engaged in the toothed drum at one end and with the swinging guides on the other or forked end. The cage is pulled out of the shaft when the toothed rack travels through the teeth on the drum. The swinging guides are pulled out until the swinging ends communicate with the set of stationary guides in the empty compartment in the cage pit. The "Little Tugger" is stopped at the proper time to permit the ends of the swinging guides, that are carrying the cage, to be changed to communicate with the guides in the pit in the empty compartment. The mine hoist engineer is signaled to lower, and the cage on the swinging guides is lowered onto the stationary guides in the pit.

Hecla in midwinter. Both photographs were taken at 9.30 P. M.



Left—Skip-changing equipment.
Top—Interior of blacksmith shop.
Bottom—Corner of blacksmith shop where are placed the four No. 5 "Leyner" sharpeners and associate Ingersoll-Rand furnaces.



How part of Hecla appears when looking down the canyon.

When enough slack has accumulated to permit the removal of the pin that fastens the rope to the cage, the operator removes it and changes the rope to the other cage that is at rest in the other stall in the pit. The swinging guides are then moved by the "Little Tugger" to the other set of stationary guides in the pit that are holding the cage that the rope is now fastened to. With this done the mine hoist engineer is then signaled to hoist the cage until the cage rests on the swinging guides. The "Little Tugger" then runs the toothed rack back until the swinging guides are again in place in the shaft, when it is again locked and the other cage becomes ready for operating.

The floor of the shaft house on that side of the shaft where the cage pits are situated consists of a large steel plate that is movable but held in place by the toothed rack that also holds the swinging guides in place when two curved arms, fastened by hinges to the upper side of the plate on one end and to a toothed rack crosshead on the other, engage the plate with the rack. When the swinging guides are moved outward, this section of the floor also moves with it so as to open a passage for the cage as the cage is moved outward over the stationary guides in the pit. This plate floor-section slides and rests on I-beams that are fastened into the concrete floor and secured to the concrete lining of the shaft. When the cage is returned on the swinging guides to the shaft, the steel floor plate moves with it and again goes back to place and is held there when the rack is locked.

While this description may seem lengthy and the apparatus appear complicated, the whole arangement is, in fact, decidedly simple and very efficient. The cage changing can be done so quickly, and without the slightest hitch, that one can look at it during the operation and scarcely realize what is happening before the maneuver is completed. It is nothing unusual for one man to change a cage within an interval of only one and a half minutes from the time one cage is stopped on the swinging

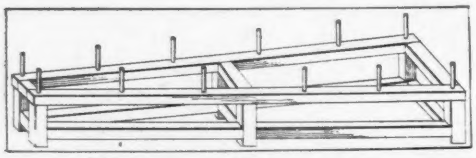


Fig. 1—Design of rack to hold steels.

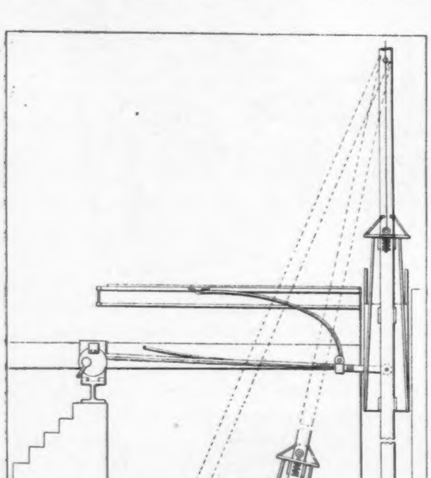


Fig. 2—General scheme of cage-changing apparatus.

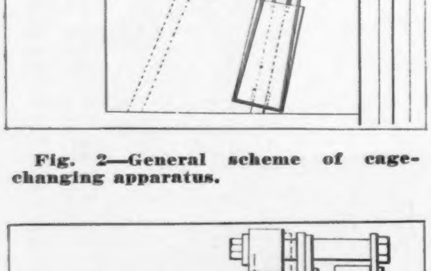


Fig. 3—Illustrating end of toothed rack and toothed drum. Dotted lines indicate how lock drops over end of toothed rack, with locking pin in place.

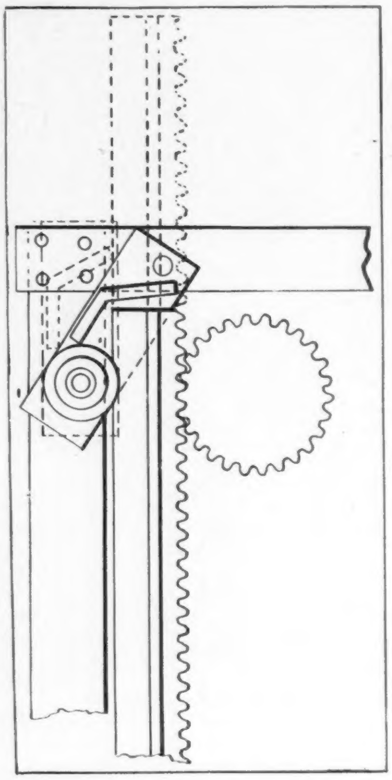


Fig. 4—Side elevation of flat-iron frame which supports roller and locking device and locking pin. Dotted lines indicate toothed rack in operation and lock unlocked.

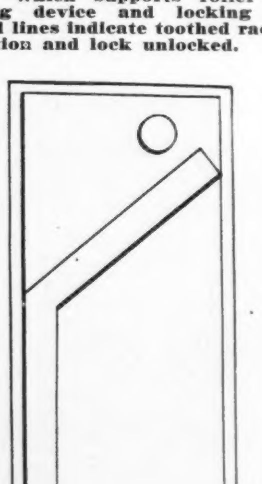


Fig. 5—Lock made of ½x3½-inch flat iron, with ½ x 2½-inch flat iron bent and welded on.

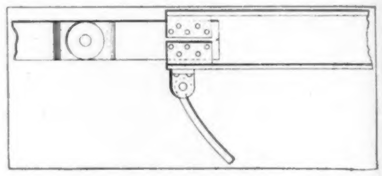


Fig. 6—General construction of crosshead and guides and the rollers that follow on guides.

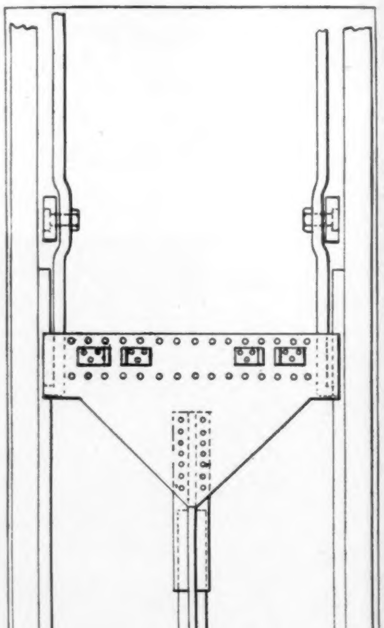


Fig. 7—Side elevation showing construction of crosshead and curved arm that connects with floor plate—also wheels that follow the guides.

guides in the shaft until the other cage is back in the shaft and ready for work.

The accompanying sketches will help to an understanding of the manner in which the cage-changing operation is performed and the equipment used for that purpose. Figure 2 is a general side elevation of the complete equipment showing the method of operating. Figure 3 is an end view of the toothed rack and a general view of the toothed drum of the "Little Tugger" hoist. It also illustrates the roller that serves to keep the toothed rack in mesh with the drum—the roller being placed at just the right distance above the toothed rack to permit the toothed rack to pass under it. This roller is held in position by a frame made of flat iron fastened to the base of the "Little Tugger" with angle iron and to the top part by flat iron pieces with holes drilled at the proper point to be engaged by studs that hold the cover plate on the "Little Tugger." A heavy bolt passes through the roller and the main upright flat iron frame to another piece of flat iron that is engaged by the cover plate studs that serve as a shaft for the roller to run on. The dotted lines indicate the locking device and the locking pin when locked.

Figure 4 is a side elevation of the locking device and an end view of the roller and a section of the "Little Tugger" drum. The frame that supports the roller and the locking device is shown, as is also the end of the pin which holds the locking device in place when it locks the toothed rack. The dotted lines indicate the rack and the locking device when in operation. Figure 5 is a larger view of the lock which is made of flat iron—one piece being bent and welded on at right angles to the other.

Figures 6 and 7 show the manner in which the crosshead and the crosshead guides, which serve to guide the forked ends, are built and operate. The crosshead is built on at the point where the fork in the toothed rack begins. Figure 6 gives a general idea of the construction of the forked end of the toothed rack. It also illustrates the crosshead and the crosshead guides. This drawing shows the wheels that follow in the metal guides that are fastened to timbers. Figure 7 shows one of the wheels that travel on the metal guides, an end view of the crosshead, and the manner in which the curved arm that engages the floor plate is also engaged by the hinge to the crosshead.

Canadians are apparently spreading butter thicker upon their bread. According to a bulletin issued a short while back by the Bureau of Statistics, the per capita consumption of cheese and butter in Canada has shown a steady increase in recent years. For example, the consumption per capita of butter in 1922 was 26.22 pounds and in 1924 it was 27.55 pounds. The individual Canadian ate 3.04 pounds of cheese during 1922, and he made away with 3.25 pounds in the course of the year just gone.

The Palacio Salvo, now under construction at Montevideo, Uruguay, is considered, for the moment, to be the tallest reinforced concrete building in the world: 28 stories, and 103 meters, or about 328 feet, high.

Portable compressor doing service afloat.

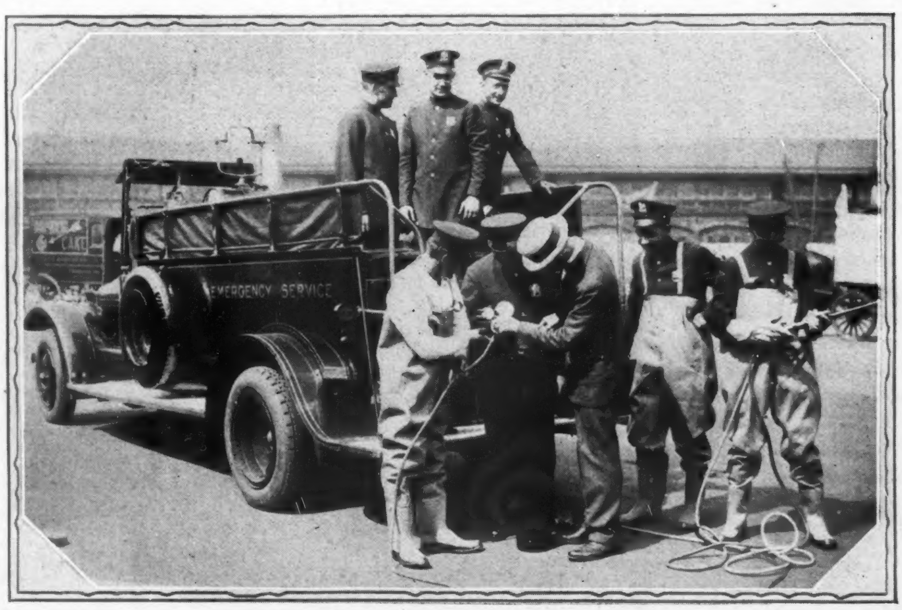
TWO PORTABLES PUT TO SEA

THOUGH all of us are familiar with the sight of portable air compressors about the streets operating various kinds of pneumatic devices, there are but few who can imagine a portable putting to sea to perform the same sort of service aboard a ship. Here we have a record of two such machines that have done this very thing, and they bid fair to gain a permanent place in marine service.

Ships, like everything else, have to undergo occasional repairs. To put a ship in dry dock for repair is an expensive proposition and one that should be avoided if it is possible to do the work while the boat is afloat. Riveting, drilling, chipping, calking, scaling, etc., invariably have to be done on such jobs and compressed air is the best means for doing it.

Heretofore compressed air for repair work, inside a vessel and on the outside above the water line, has been supplied by stationary compressors installed on scows and welders, and for the duration of the job it was necessary to tie either the scow or the welder alongside. A scow or a welder represents a considerable investment.

The Buffalo Dry Dock recently equipped their scow with two portable compressors. This enables them to take care of rush work incident to the resumption of traffic on the lake routes, and for minor repairs they simply hoist one of the portables aboard a craft and take the scow on to other jobs.



International Newsreel, N. Y.

Two motor trucks of this description have been bought for the police department of Greater New York for use in emergencies of various kinds where oxy-acetylene torches can be used to advantage. Each truck represents an outlay of $7,000, and the crew will consist of one lieutenant, three sergeants, and twenty patrolmen.

Testing the action of a helium-oxygen mixture by decompressing a guinea pig in a specially constructed pressure chamber.

NEW USE FOR HELIUM

HELIUM—that rare gas which is so invaluable in the operation of giant dirigibles because of its noninflammability—is now to be used for the benefit of the deep-sea diver and the "sand hog." It has been established that by employing a mixture of helium and oxygen it is possible to shorten the time now required to decompress these submarine and subterranean toilers after they have done their daily bit under the high pressures to which they are subjected. But of still greater importance is the fact that, as a result of this discovery, the danger of caisson disease or compressed-air illness—to which such workers are exposed—will be greatly minimized; and the range of submarine and underground engineering may therefore be considerably extended.

Modern engineering depends largely on the use of compressed air, that is—it is only by the aid of compressed air that many deep foundation jobs, underwater tunnels, and bridge projects can be put through. In these different undertakings numerous men are employed under varying degrees of air pressure—depending, of course, on the depth to which they must go. To restore these men to normal or atmospheric conditions on returning to the surface they must undergo decompression in specially equipped air locks. Heretofore, mixtures of nitrogen and oxygen have been used for the purpose of decompression, which is a slow process. Not only that, but nitrogen has a tendency to withdraw very slowly from the body fluids and tissues and to leave bubbles in the blood. These bubbles are the cause of caisson disease or "bends."

Experiments with rats, guinea pigs, and other small animals—conducted in the gas laboratories of the Bureau of Mines at Pittsburgh, Pa.—have shown that helium is less soluble than nitrogen and, therefore, the blood takes up more nitrogen than helium in a given time. Helium also diffuses quicker in the body fluids and tissues—thus more rapidly eliminating the gas from the tissues during decompression and minimizing the risk of forming dangerous bubbles. In short, the substitution of helium for nitrogen produces a mixture that is as respirable as the normal atmosphere.

It has been determined that decompression by the aid of the helium-oxygen mixture can be safely accomplished in as little as one-sixth the time required when using nitrogen and oxygen for the purpose. This result was confirmed by certain preliminary tests on men. This achievement marks a great step forward in the art; and it is confidently predicted that it will henceforth be possible to subject divers and sand hogs to higher pressures—thus enabling them to work with greater security for longer periods and at depths heretofore deemed prohibitive.

Sand hogs working in a big pressure chamber resting upon a river bed. The care required in decompressing the men before returning them to the atmosphere depends upon the abnormal pressure and the length of time to which they have been exposed to it.

SNOWSHOES FOR HORSES

TRANSPORTATION of supplies to some of the remote mines in northern British Columbia and Alaska is usually done during the winter season by means of dog teams. In some cases, however, horses are employed for this work and are equipped with special snowshoes so that they will not sink and flounder.

The accompanying photograph was supplied us by Mr. E. S. Winslow, General Sales Manager of the Canadian Ingersoll-Rand Company, who recently returned from a trip to Stewart, B. C., and Hyder, Alaska. The picture shows a horse, fitted with snowshoes, hauling supplies to the world-famous Premier Mine.

Fitting snowshoes to a horse.

Mr. Winslow says that the horses soon become accustomed to wearing this novel type of hoof gear, and when once used to wearing them the sagacious animals will not venture across deep drifts or snow-filled glacial crevasses unless they have these shoes on. In some of the valleys, so it seems, snowfalls of 50 feet or more are not unusual.

INSULEX

THIS is the name of a new and curious material produced and being applied in Canada and having, it is claimed, valuable and most desirable properties. It is a poured-in-place insulating material, a fireproof and vermin-proof gypsum product, used especially for preventing heat losses and for sound deadening. As described in *Contract Record*, it is prepared in powder form and contains a "mineral yeast" which becomes active on the addition of water. As soon as this is done and the mixture is stirred, it begins to rise like a loaf of bread in the making. It is then poured in place and continues to rise after being poured. When the rising ceases the Insulex sets in twenty to thirty minutes. After setting, it contains innumerable air cells, which account for its insulating efficiency and earn for it the name of "mineral cork."

Up-to-Date Sewage Disposal Plant at Dinuba

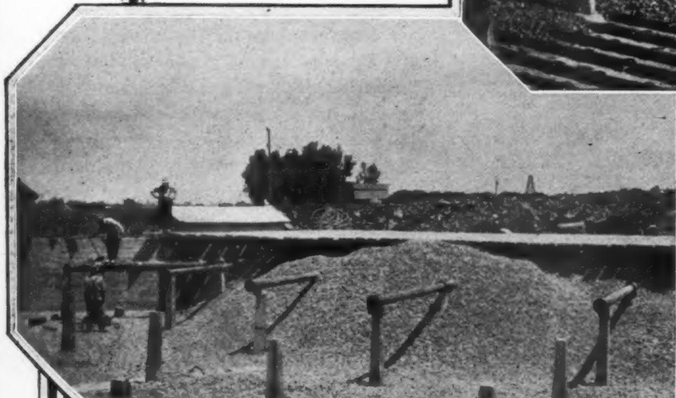
By R. C. R. MORSER

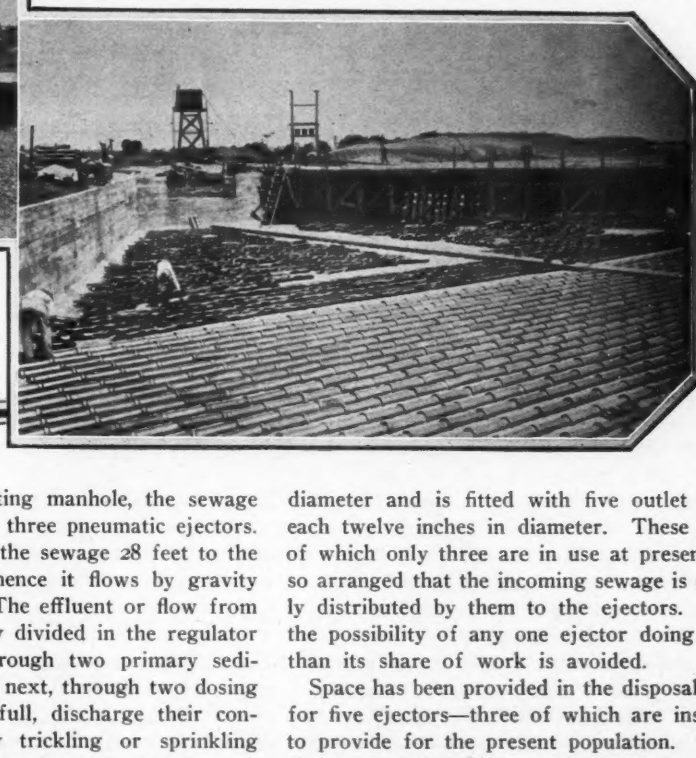
A MODERN sewage disposal plant has recently been constructed by the City of Dinuba, Calif., which should be of interest to sanitary engineers and to officials of small, thriving cities and towns. Dinuba, which lies in the San Joaquin Valley about 35 miles southeast of Fresno, is the center of a large fruit-growing region. There are 15 fruit-packing plants in the community, which is one of the largest raisin shipping points in California.

A conservative estimate places the present population of Dinuba at 5,000—an increase of 80 per cent. since 1910. While the future growth of the town is problematical, still it is reasonably expected that it will continue to develop as it has in the past and reach a population of about 20,000 within the next 25 or 30 years.

The sewage disposal plant has therefore been designed for a population of 10,000; but, by the installation of additional units, can readily be increased to take care of 20,000. As the machinery works automatically, the plant is operated by but one man, and he is in attendance for only a part of the day. The city's sewage is carried from the collecting system to the disposal plant by means of a 16-inch, 2-mile outfall sewer made up of vitrified-ironstone pipe sections. This outfall line is laid on a grade of 2.6 feet per mile, and carries the sewage to the plant at a velocity of about 1.2 feet per second. The accompanying flow chart diagrammatically shows the layout of the plant—the solid lines indicating the present installation and the dotted lines how the plant is to be enlarged to take care of future needs.

Drains in place—those in the foreground being covered with coarse rock and ready for the filtering material.





Above—Another view of the filters. Note the manner in which the pipes of the distributing system are supported by concrete columns.

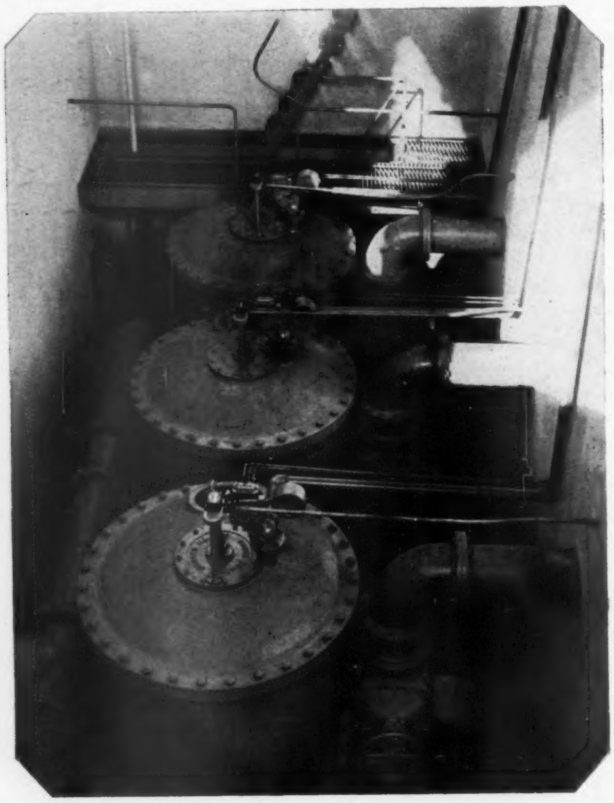
Right—One of the filter beds during construction. The main drain may be seen running from the background to the right foreground.

From the distributing manhole, the sewage flows to a battery of three pneumatic ejectors. These ejectors raise the sewage 28 feet to the regulating tower, whence it flows by gravity through the plant. The effluent or flow from the ejectors is evenly divided in the regulator and passes, first, through two primary sedimentation tanks and, next, through two dosing tanks which, when full, discharge their contents over as many trickling or sprinkling filter beds. From this point on a concrete conduit carries the effluent to the secondary sedimentation tank, whence it is discharged into an irrigation canal.

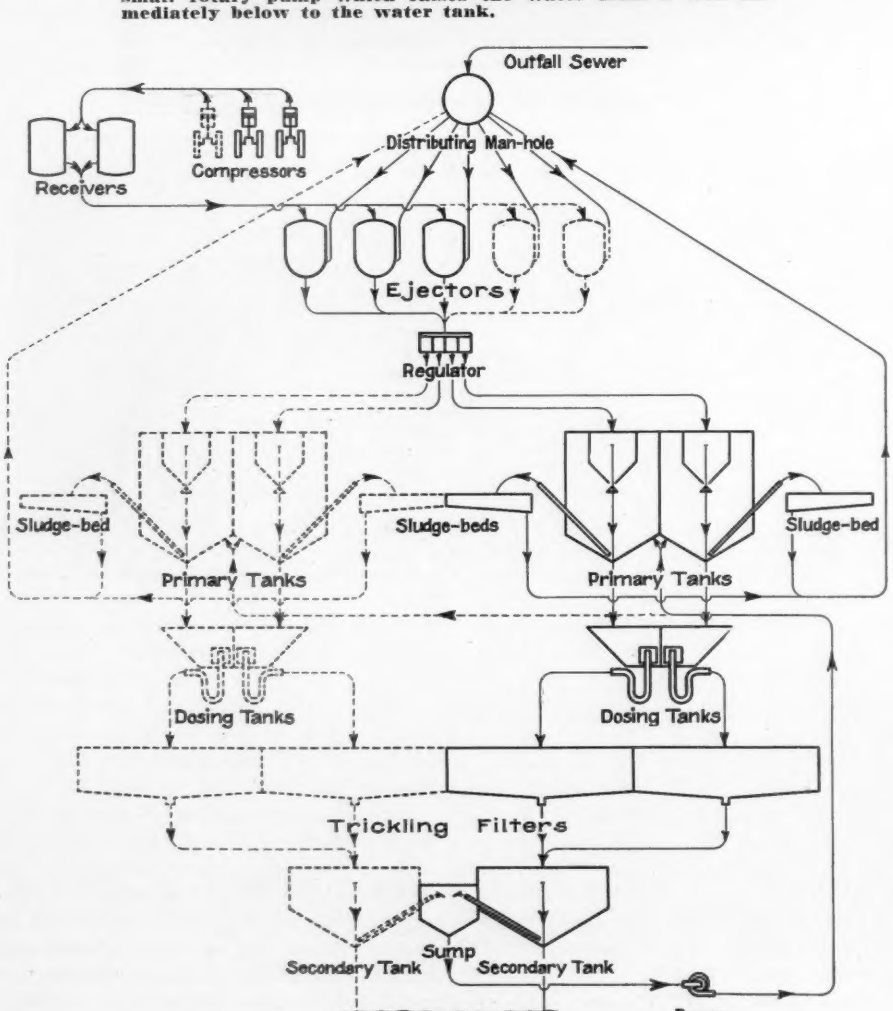
The sludge from the primary tanks is drawn off onto drying beds from which the water is drained back to the distributing manhole. After drying, the sludge is removed and used for fertilizing around the plant site and for leveling the ground about the place. The sludge from the secondary tanks is returned by means of a pump to the sludge chamber of the primary tanks.

The distributing manhole, which is constructed of concrete, is of eight feet inside diameter and is fitted with five outlet pipes, each twelve inches in diameter. These pipes, of which only three are in use at present, are so arranged that the incoming sewage is equally distributed by them to the ejectors. Thus the possibility of any one ejector doing more than its share of work is avoided.

Space has been provided in the disposal plant for five ejectors—three of which are installed to provide for the present population. These ejectors are placed in a reinforced-concrete pit in the same building which houses the compressors, motors, air receivers and their auxiliary machinery. The pit is of sufficient size to permit easy access to all parts of the ejectors; and a sump in the center of the pit takes care of any slight seepage of ground water.



Ejector pit. At the left under the landing may be seen the small rotary pump which raises the water from a well immediately below to the water tank.



Flow sheet of Dinuba plant.

The ejectors are of the Shone type, manufactured by the Yeoman Brothers Company, of Chicago, Ill., and each has a capacity of 500 gallons. This type of ejector was so well described by Mr. J. Johnstone Taylor in the February, 1924, issue of *Compressed Air Magazine* that it is unnecessary to give a detailed account of it here. But one point, very pertinent to all sewage disposal plants using a settling process, was not touched upon by Mr. Taylor, and that is that the pneumatic ejector does not subdivide the solids in the sewage as does a pump. This subdivision of solids greatly retards settlement. Centrifugal pumps tend to reduce a considerable portion of "settleable" solids to a state closely approaching the colloidal, thus greatly interfering with efficient and satisfactory sedimentation.

The ejectors are equipped with the latest type Shone operating valves. This arrangement places the pilot valve on the ejector pot. The operating valve is on the floor of the compressor room instead of in the ejector pit, thus removing it from possible contact with sewage in case of failure of the compressed air supply. Each ejector is equipped with a Veeder ratchet counter so arranged that it registers every discharge of the ejector. By this means the ejectors act as meters—that is, they measure the actual amount of sewage flowing through the plant.

Compressed air for the operation of the ejectors is supplied by two Ingersoll-Rand, Type "ER-1" compressors. These machines have a 14-inch bore and an 8-inch stroke. Each unit is driven at 250 revolutions per minute through short belts and idler pulleys by a 30-H.P. Robbins & Meyers induction motor of the squirrel-cage type and is equipped with an intake unloader, cylinder relief valves, a starting unloader, and a safety valve and a globe valve for shutting the compressor off from the air receivers.

Each compressor can be controlled either by the unloader and the cylinder relief valves or by automatically starting and stopping the motor by a pressure regulator. This arrangement was desired because the load on the compressors, for some time, will be light, and unloading would require an excess of power. Until the normal flow of sewage materially increases, both compressors will be operated by the automatic start-and-stop control. To insure ease of starting when using the automatic start-and-stop feature each compressor is provided with a Type A-69 starting unloader. When the demand for air increases, one compressor will operate unloading while two units will be set for automatic start-and-stop control. However, should one compressor be unable to supply the air required, then a second compressor will automatically cut in. Again, should two compressors not be able to furnish the necessary air, a third machine will automatically be put in service.

To accomplish the aforementioned results, one pressure regulator is set at a cut-in pressure of 15 pounds and a cut-out pressure of 24 pounds, while the second regulator is set at a cut-in pressure of 14 pounds and a cut-out pressure of 23 pounds. All unloaders are

set to cut in at a pressure of 16 pounds and to cut out at 25 pounds. Each motor may be controlled automatically by either pressure regulator—thus making it possible to shift a compressor from one duty to another without having to adjust the pressure regulators or unloaders in any way. Furthermore, each motor is so wired that it may be started manually by its master switch. In this case it runs unloading. These settings may seem a bit fine, but experience has shown that both the pressure regulators and the unloaders are capable of performing to these close limits in a most satisfactory manner.

By means of an Esterline-Angus recorder, consisting of a chart roll and an adequate number of pens, the performance of each ejector and each compressor is visually indicated. When a compressor has stopped or an ejector has emptied, the respective pen returns to its normal position. Thus, by glancing at the chart, it is possible to tell whether or not each unit is doing its share of the work. In other words, the attendant—upon his daily inspection of the plant—knows if each piece of equipment is functioning properly. The chart also shows the hourly variations in the flow of sewage, and this is an advantage.

The flow regulator consists of a long vertical pipe, gradually increasing in size toward the top. All eddy currents and uneven velocities in the sewage, which has an upward flow, are thus avoided. Four weirs are arranged about the top of the vertical pipe in the form of a square. These weirs are of equal length and set at the same elevation so as to insure a uniform flow into their respective hoppers which, in turn, will ultimately feed into four primary tanks. Though one or more of the primary tanks may be shut down, an even flow is insured to those remainings in operation.

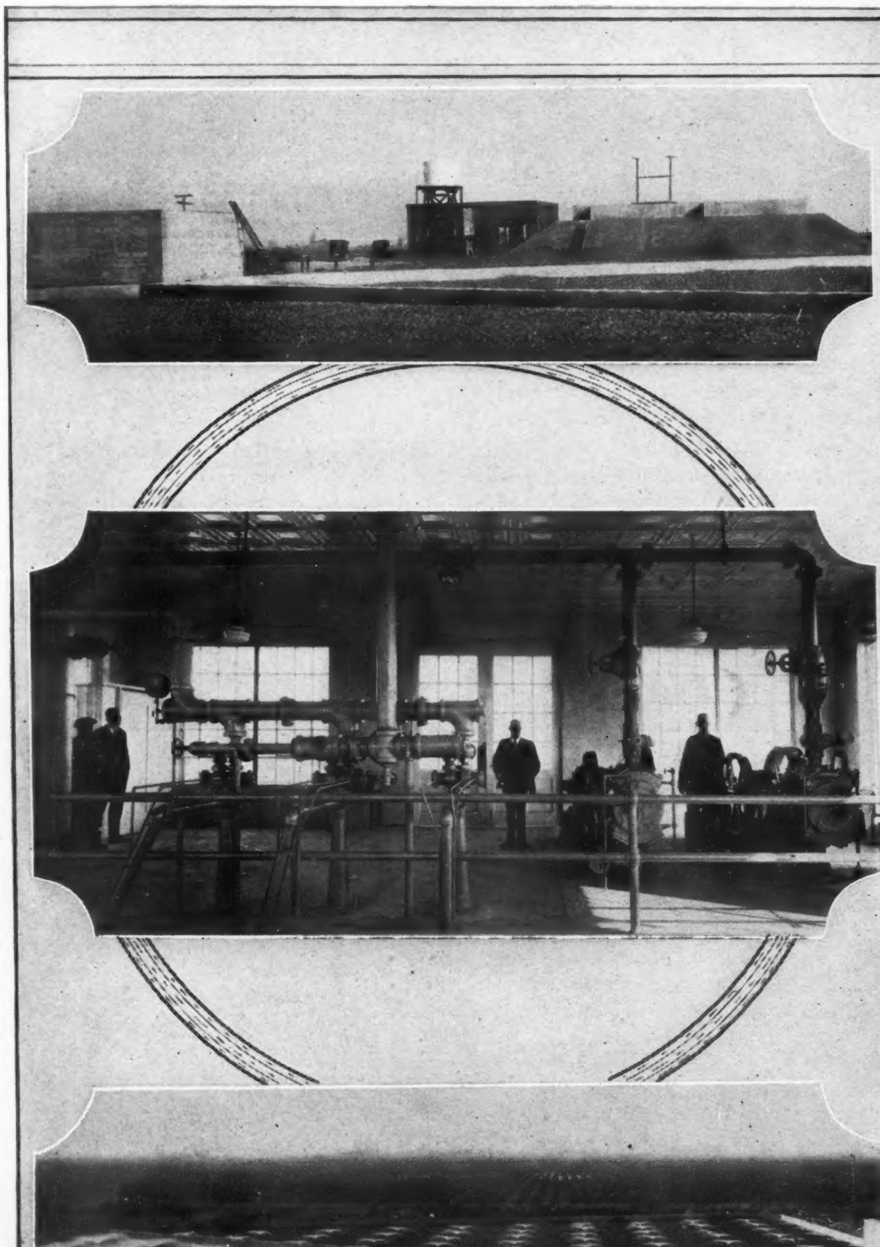
Two primary settling tanks are at present in service. They are of the 2-story type—the sewage flow being confined entirely to the upper or sedimentation chamber. The flow through this chamber is at a very low velocity—the mean flowing-through period being about 2½ hours. During this period about 60 per cent. of the suspended solids are settled out. These solids fall upon the sloping bottom of the sedimentation chamber and slide downward through slots into the sludge chamber, which is designed to provide storage for about six months' operation. The sludge in this chamber is decomposed by a biochemical process induced by the action of anaërobic bacteria.

A considerable amount of gas is produced during the process of decomposition. Part of this gas is absorbed by the sludge, itself, and part rises to the surface. In fact, the gas rises in sufficient quantity to agitate the sludge and thus to present all the surfaces of each particle to the digestive action. The rising gas, with such small particles of sludge as it may bring with it, is prevented from entering the sedimentation chamber by a triangular-shaped beam, immediately below the slots, which also deflects the gas into scum chambers. The decomposing sludge is never permitted to rise above a point about eighteen inches below the slots, in that way providing free and unobstructed passage for the settling solids.

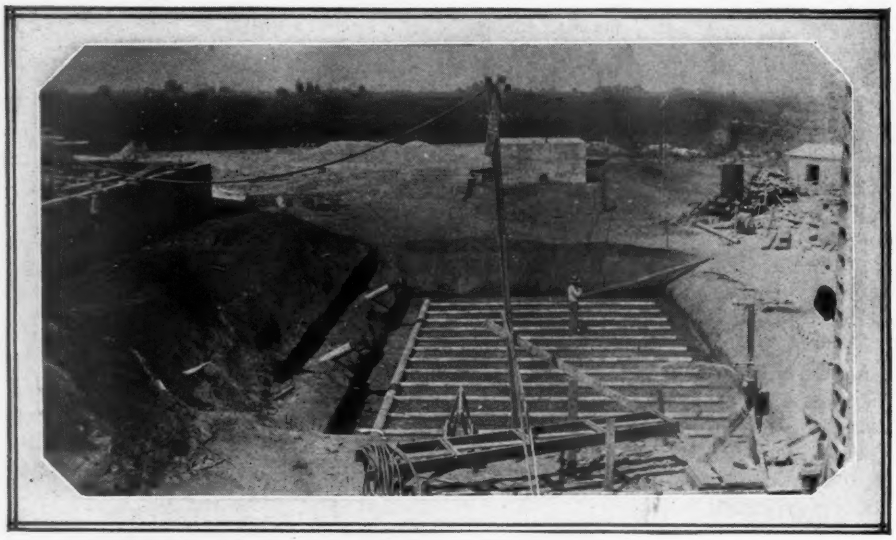
The inflowing sewage enters the primary tanks through a small compartment or surge tank, holding about 750 gallons, whence it flows through adjustable orifices so placed across the end of the sedimentation chamber as to equally distribute the flow throughout the width of the chamber. By a proper adjustment of the orifices, all surges induced by the discharge of the ejectors are eliminated.

The outflowing sewage leaves the tanks by way of a weir which extends across the end of the sedimentation chamber and assures a uniform, even discharge. Papers and other floating matter are prevented from passing out of the tanks by adjustable scum boards, located at right angles to the direction of flow, at each end of the sedimentation chamber.

Once each month about one-sixth of the accumulated sludge is drawn from the sludge chamber by means of valve-controlled pipes



Top—General view of Dinuba sewage disposal plant.
Center—Interior of the ejector building. At the right are the air compressors.
Bottom—Filter beds with sprinklers in operation.



Sludge beds, during the course of construction, with the under drains in position.

lying upon the sludge beds. Here, likewise, large quantities of gas are produced due to the release of the hydrostatic pressure. This gas is of great assistance in drying the sludge — which is nearly odorless, making it very porous and tending to float it upon the water which, in turn, drains off rapidly. After a few days' exposure to the air, sufficient moisture has been withdrawn from the sludge so that it can be readily spaded for purposes of removal.

The sludge beds consist of 4-foot excavations in the sandy soil. The bottoms of these beds are underdrained with tile embedded in graded gravel about fifteen inches in depth. The sludge is discharged upon concrete aprons, in the sludge beds, and the liquid is collected in a drain pipe and discharged into a distributing manhole at the end of the outfall sewer.

To obtain the most satisfactory results from a trickling filter it is necessary that the flow of sewage be as evenly distributed over its surface as possible and that there be a period of rest between each delivery of sewage in order that the filtering media may replenish its supply of oxygen. These conditions are assured in the case of the Dinuba plant by means of dosing tanks, automatic siphons, and a distributing system consisting of pipes, graduated in size, and sprinkling nozzle.

No sprinkler nozzle yet designed will produce an even distribution of sewage over the surface of a sprinkling filter when operating under a constant head, thus necessitating a varying head on the nozzles. As the area covered by the spray from a sprinkler nozzle is greater for higher heads than for lower heads, it is required that the volume of sewage supplied to the sprinklers be graduated to the different heads. To fulfill these conditions, and to permit of the intermittent dosing of the filter, the effluent from the primary tanks is discharged into a battery of two dosing tanks. These tanks are hopper shaped in design and evenly distribute the sewage throughout the entire filter area.

Within each dosing tank is an automatic dosing siphon which starts to empty the tank when the sewage reaches a predetermined height and continues the discharge until the sewage in the dosing tank reaches a fixed level. At this point the siphon is vented and remains out of operation until the level of the sewage in the dosing tank has again reached the predetermined height and trips the siphon. The mean time for a complete cycle is about 17 minutes, and of this about 6½ minutes are required for actual dosing.

The sewage is distributed to the sprinkler nozzles by means of a system of cast-iron pipes varying in diameter from four to sixteen inches. These pipes were placed twelve inches below the surface of the filter beds for two reasons: First, the length of the riser pipes from the distribution main to the nozzle is thereby reduced to a minimum and, second, in case of stoppage of the pipes very little of the filtering material need be removed to gain access to them. There are 55 nozzles, with 13/16-inch orifices, to each filter bed. The sprinkler heads are located at the apices of equilateral triangles having sides fifteen feet in length.

The walls and floor of each filter bed are of reinforced concrete — the entire floor area being drained by 6-inch half tile laid on 18-inch centers with open joints and sloping toward a central concrete drain. The filtering material is a coarse-grained, carefully selected trap rock ranging in size from 1½ to 2½ inches. All finer materials were rejected and great care was taken in placing the rock to eliminate all dirt and organic matter.

The action of a trickling filter is not that of a strainer: the sewage is distributed over a large area and, in trickling down through the filtering material, comes in contact with oxygen and other purifying agents. After such a filter has been in operation for a short time, each piece of crushed rock becomes coated with a gelatinous substance. Just what action take place is unknown, but it would seem that the suspended solids in the sewage and some of the colloids adhere to the bacterial jelly which coats the rock particles and are either absorbed or are directly acted upon. Furthermore, a great many worms are found in the filtering material, and it is quite probable that these, together with insects within the filter, aid in purifying the sewage.

The regulator with the four hoppers surrounding the central uptake pipe.

Trickling filters are self cleaning. It is therefore to be expected that the effluent from filters of this type would contain as large a percentage of suspended matter as is found in the influent. In several large plants, where careful records have been kept, the effluent shows a slightly larger amount. This is due to the precipitation of some of the colloids. The suspended solids in the effluent are, however, different in character from those in the sewage. They are much more stable and somewhat granular.

In order to remove the suspended matter from the effluent of the trickling filter, secondary sedimentation is used. The filter effluent is passed through a shallow, hopper-bottomed tank, whence the settlings or sludge is drawn off weekly by means of pipes. This sludge is drawn into a sump from which it is pumped back and deposited in the sludge chambers of

the primary tanks, where it undergoes digestion. The mean sedimentation period in the secondary tank is two hours. The effluent from the secondary tank, which is the final product of the plant, is discharged into an open irrigation canal at the plant site; and, as it is odorless and in no way offensive, is used in conjunction with the canal waters for irrigating purposes.

Pneumatic pumping in place of centrifugal pumps may be used in many disposal plants to good advantage. The overall efficiency, though lower for ejectors, is maintained fairly constant throughout a long period of years. The cost of repairs and replacements is almost negligible. The use of ejectors does away with small restricted passages, hence clogging, and it is therefore unnecessary to screen the raw sewage. The pumping rate is automatically regulated by the amount of sewage reaching the ejectors, thus avoiding the use of sumps and the risk of putrefaction. The suspended solids are not as finely divided as in the case of centrifugal pumping and are, therefore, more readily settled—permitting a shorter period of sedimentation. The initial cost of a pneumatically operated ejector plant is greater than that of a centrifugal pumping plant, and, because of larger power consumption, the operating costs for ejectors are also slightly higher than those for pumps.

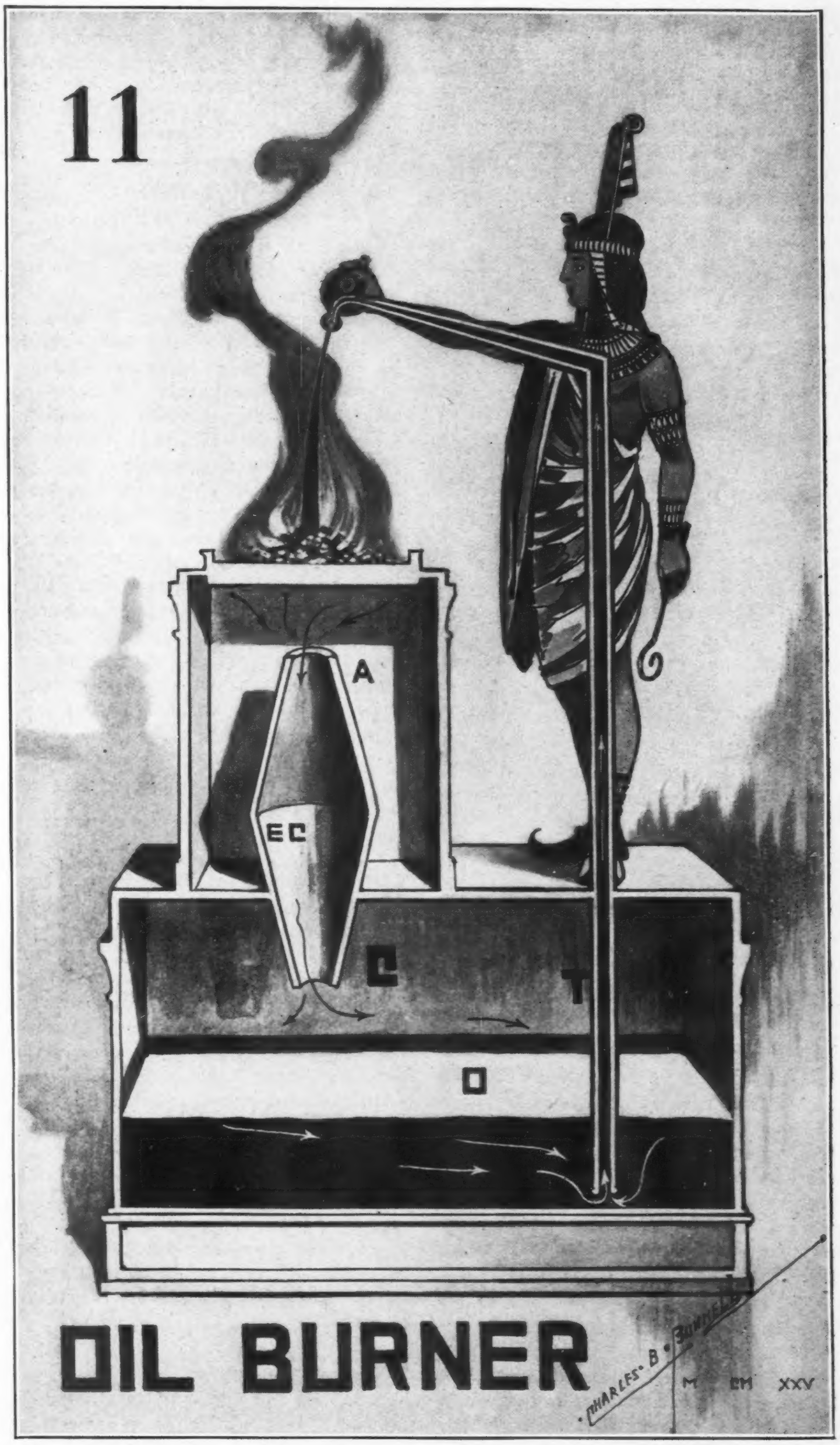
The Dinuba disposal plant has been in service for over a year and has proved a success in every way. The operating costs have been exceedingly low, the efficiency high. The system reached a stable biological condition in a very short period of time; and Mayor H. L. Andrews, other city officials, and the citizens of Dinuba have expressed themselves as being well pleased with the results.

The plant was designed by the author and built by Mr. Harry Gould, of Sacramento, Calif., under a subcontract from the Federal Construction Company, of San Francisco. Mr. Charles E. Sloan, also of San Francisco, was the consulting engineer, and Mr. Hugh Stone the resident engineer in charge of construction. The plant cost, complete, $145,612, and the present operating costs amount to about $190 per month.

THE BIGGEST CARPET

THE latest "biggest of its kind in the world" is a carpet covering the floor of a restaurant in the Wembly (London) Exhibition. It is a blue-and-gold Saxony, 53x43 yards, or more than half an acre. It weighs five tons; cost about $6,000; and twenty men were required to lay it. A man with a hand carpet sweeper, and a swath of one foot, would have to travel more than four miles to sweep it all, and by the time this was done he would have to begin again.

The building of automobiles is booming elsewhere than in the United States. In England, automobile firms are active, and light-car makers are working day and night shifts. Favorable weather has greatly stimulated sales.



THE oil burner as a source of mechanical energy seems to most of us to represent a thoroughly modern development. Undoubtedly this is true when applied to the widespread use of petroleum as a power medium. Even so, ancient mechanical geniuses and engineering writers of many centuries ago were not unaware of what could be achieved by the cunning utilization of the oil burner.

Here we have a present-day artist's conception of Hero's Eleventh Proposition. The Greek writer's text is thus made graphic by Mr. Bunnell: The Altar or air-tight box, "A," is of bronze, and upon it is a charcoal fire. The heat of the fire expands the confined air beneath and forces the air down through an expansion chamber, "EC," and thence into the chest, "C," which is partly filled with oil, "O." The pressure exerted by the expanded air acts downward upon the oil and forces that fuel up through the pipe, "T." and onward through the figure to the extended arm carrying a small jug. The oil spurts out of the jug mouth and falls upon the glowing bed of charcoal, thus increasing the flame. When regulated, the fire could in this way be made to burn brightly for a considerable time, and the oil would continue to flow as long as the expanding heated air was able to act upon it and to raise it to the outlet.

Compressed Air Magazine

—Founded 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:

Bowling Green Building, No. 11, Broadway, New York City. Tel. Bowling Green, 8430

Publication Office: Somerville, New Jersey

TERMS OF SUBSCRIPTION

$3 a year, U. S. A., American possessions and Mexico; all other countries $3.50 a year, postage prepaid. Single copies, 35 cents. Back issues more than six months old, 75 cents each.

EDITORIALS

HOW COMPRESSED AIR AIDS AUTOMOBILE INDUSTRY

SPEED in output and a high grade of workmanship are now required in the building of automobiles on a mass production scale in this country. There was a time, and that was not so long ago, when the manufacturer could proceed at a comparatively leisurely pace, build his cars rapidly enough to meet market demands, and make a satisfactory profit the while. Today, the conditions imposed upon him are different, especially if he be the maker of a popular type of automotive vehicle.

Accordingly, the manufacturer is now required to meet even more exacting structural demands, and if he is to show a satisfying profit when the year's business is done, it is needful that his volume of output be greatly increased, and that his cars be comfortable, susceptible of ready control, and that they will give a gratifying return in service to the owner. The attainment of these several ends means that every stage of the work must be systematized, every operation standardized, and the product pretty thoroughly tested before it issues from the plant. Incidentally, time must be saved wherever it is possible to do so and the labors of the worker so lightened that his performance will measure up to requirements from the beginning to the end of the working day.

In this issue it is our privilege to tell of some of the many ways in which compressed air aids in speeding up output and in assuring a fine order of workmanship in one of America's most modern automobile factories. The details should be of interest to owners and prospective owners of cars of this kind.

MOTORSHIP TONNAGE GROWS STEADILY

ALTHOUGH the statement issued by Lloyd's Register of Shipping for the first three months of the current year shows shipbuilding generally to be at its lowest point since the World War, nevertheless the decline has one outstanding significant feature. That is to say, while the building of steam tonnage has fallen steadily for some while the orders for the construction of vessels to be driven with oil engines have multiplied to a marked degree. This trend has become so pronounced that nearly half the world's shipbuilding is of this newer type. An especially interesting angle of this movement was disclosed not long ago when the fact was brought to light that ship owners rather than shipbuilders and engineers were responsible for the demand for oil engines instead of steam engines for prime movers. In short, the practical man—the owner and operator—the man that has to make his ship pay, has chosen the motor-driven vessel because of its proved economies.

LOST TREASURE SHIP LOCATED

SOMETHING like fourteen yars ago, the northbound steamship *Merida*, on her way from Mexico to New York, was rammed by another vessel and sank during foggy weather in the open sea some miles off Cape Charles, Virginia, in water variously reported to be 50 fathoms and more deep. At the same time, rumor had it that the ship carried in her strong-room bullion and other treasure to the value of several million dollars. There was more or less of a mystery about that, and it was hinted that a considerable part of the wealth had been shipped out of Mexico by certain revolutionary interests. Be this as it may, an expedition was subsequently outfitted to search for the submerged wreck which went to the bottom during hours of darkness and under circumstances that made it impracticable to mark the position. Those searchers were unsuccessful.

Now we are informed that the wreck has been located and that it lies at a depth of 35 fathoms. Furthermore, it is asserted that steps will soon be taken to recover the $4,000,000 in treasure held inside the craft. To achieve this, divers will have to cut a large opening in the ship's steel side, and every step of the task will bristle with hazards. The salvors will profit by the experiences of men engaged heretofore in kindred undertakings in America and abroad, but the burden of ultimate success will rest upon the shoulders of expert divers who, in their turn, will depend upon the life-giving compressed air which will be forced down to them every moment they work under water.

OUR TRADE BALANCE A BILLION IN OUR FAVOR

THE foreign trade of the United States for the fiscal year which ended on the 30th of June, showed a balance of $1,042,681,497 in our favor, and this despite the fact that our imports for the period had a total value of $3,824,972,847.

Both the imports and the exports for the fiscal year exceeded those of any of the previous five years. Furthermore, the favorable balance was greater than that of any of the immediately preceding three fiscal years, although it was less than that for the year ending June 30, 1922.

This continued predominance of a balance in our favor is a heartening and a healthy sign, because it is the best evidence that our factories, our farms, and our mines are supplying not only every domestic need but are turning out a surplus that can be disposed of profitably to ready takers in the markets of the world.

ARCHAEOLOGISTS TO TURN ATHENS INSIDE OUT

SOME years back, when the subway was dug which now connects Athens with its neighboring port, Piraeus, the excavators came upon the remains of the ancient classical city of Athens at depths ranging from 25 to 30 feet below the present surface of the ground. These disclosures were made in a populous section of Athens of today, and have tantalized the archaeologists ever since. There is an ambitious project now afoot which has for its goal the uncovering of a large area of the old city of classical renown; and there is ample reason to believe that this work, if carried out, will bring to light historical facts and records of incalculable value.

Heretofore, research work of this nature in Greece has been carried out by a department of the Greek Government, officially known as the Greek Archaeological Society, but owing to a lack of public funds the government has been obliged to look to outside help to carry on a work which concerns all civilized peoples. Accordingly, forty American colleges will join hands and obtain the necessary monetary support to raze and to clear away approximately twenty blocks of modern Athens so that the historical ground on the hillside in question may be bared to the light of day with its ancient monuments probably largely intact and as they were when the Greek people were a force that even ancient Rome and other nations of the period feared. To carry out the plans now in process of formulation and to compensate the present property owners and residents involved, will call for an expenditure of something like a million dollars.

Referring to this undertaking, the New York Times recently quoted Professor EDWARD CAPPS, head of the Greek Department at Princeton University, and chairman of the Board of Managers of the American School of Classical Studies at Athens. According to this authority: "It is impossible to exaggerate the importance of the work. It should result in even more important disclosures con-

cerning classical civilization, history, and art than resulted from the excavations at Pompeii, as Athens was of far greater importance than Pompeii. It is not too much to say that our ideas may be revolutionized."

It seems that a good many of the buildings now standing upon the site to be explored are of stone, and these must be demolished and cleared away before the underlying ancient structures can be uncovered. Plainly, money can be utilized to best account and results obtained in the shortest time by employing modern excavating facilities; and in this work, compressed air and pneumatic tools will have a chance to bring to light some of the evidences of Greece's glory in the centuries gone.

UNIQUE AMONG HIGHWAYS

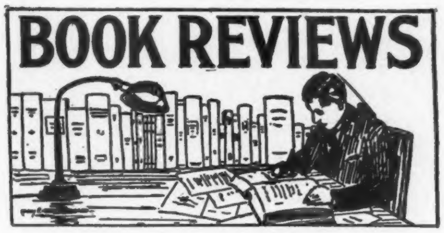
THE recently completed Wendover Cut-Off in Utah, is a 41-mile highway which is going to be a boon to motorists traveling to and fro across the desert region lying to the west of Salt Lake City. This road is unique because of the nature of the bed upon which it rests and because of the substance which really gives the rather frequently saturated soil sufficient stability to serve as a thoroughfare for vehicular traffic.

The road has been built across a mud flat which is covered with water to a depth of a foot or more at certain seasons; and the character of the soil and the extreme saltiness of the water present made it necessary to rear only a causeway of earth high enough to hold the roadbed above the surface of the water. The salt in the water acts as a binder, and this gives the road an unusually good surface.

Underlying the road there is a solid foundation composed of salt deposited in the course of ages, and the highway engineers early discovered that that bed of salt was insoluble when covered by a solution which overlies it after the period of spring evaporation has passed. As a result, the highway is built upon a firm layer of salt, and this layer is permanently protected from dissolution or disintegration by clay cut-off walls. Paradoxically, we have in this case an instable substance which actually gives stability and permanence to the structure with which it is associated.

PLATINUM

THE present position of platinum in the industrial and in the commercial world is a peculiar one. It has always been a rare metal, and our modern inventors have made it quite an essential, in perhaps minute quantities, in many lines of industry. The demand thus created has sent it to the top of precious metals—its recent price ranging at four or five times that of gold. The enormous price has created an abnormal demand among persons fond of display. The United States now "consumes" more platinum than all the other countries of the world combined; and by far the greatest amount of the metal goes into jewelry. For this purpose the demand increased from 82,000 ounces in 1819 to 106,000 ounces in 1923, while the total world output in 1924 was only about 88,000 ounces.



THE WAY OUT, by Edward A. Filene. A book of 306 pages, published by Doubleday, Page & Company, Garden City, New York. Price $1.50.

THE author has offered us a forecast of coming changes in American business and industry. As he explains on his first text page, "This afternoon I tentatively promised a publisher-friend that I would try to set down, in more or less orderly fashion, some of the convictions about successful business, sound social advance, and the durable satisfactions of life that I have arrived at in the severe but effective school of experience."

Thus, after ripe years of business relations —relations that have won him success, Mr. Filene takes up one by one various aspects of two great industrial problems now confronting America—namely, mass production and mass distribution. He deals with what he calls counterfeit wages, tooth and claw competition; labor's say in business; Fordizing America; war on waste; lower prices; shorter hours, etc. While many there are that will not agree wholly with Mr. Filene's conclusions, still he offers serious food for thought, and much that he says will be accepted without question by a large number of thoughtful persons. He has done a potentially helpful service in giving us the benefit of his judgment and of his lifetime's experience with people, business, and world affairs.

THE CARBURETOR HANDBOOK, by Ernest W. Knott, Associate Member of the Institute of Automobile Engineers. An illustrated work of 403 pages, published by Isaac Pitman & Sons, New York City. Price $2.50.

THIS volume is avowedly a book of reference written especially for the nontechnical motorist and mechanic; and it contains detailed descriptions of many popular types of carburetors with full instructions how to install, how to adjust, and how to repair them. The carburetor may properly be described as the very heart of the gasoline automobile engine, and most car owners look upon the carburetor as a mysterious mechanism which is far beyond their comprehension. While it is unquestionably wise for many people to hold the carburetor in awe and to leave it alone, still it would be of advantage to thousands of car owners and operators to have a working knowledge of the carburetors on their vehicles, because, in the last analysis, the adjustment and the performance of the carburetor determine whether or not the fuel is being used economically and to the fullest advantage. Nr. Knott's book should be helpful to those persons that want to make the most of their car on the least expenditure for gasoline.

SUPERHEAT ENGINEERING DATA. A book of 202 pages issued by The Superheater Company, New York City. Price $1.00.

THIS excellent handbook, now in its sixth edition, revised, deals with the generation and use of superheated steam and related subjects. The foreword explains the reason for being of the book: "Superheated steam is a simple and positive means for securing a remarkable improvement in the life and economy of steam prime movers, regardless of what fuel or type of boiler is used for generating the steam. The life and economy of the steam transmission system will also be increased by the use of superheated steam. In this handbook, we have endeavored to condense for ready reference the data most frequently desired by steam power-plant engineers and operators."

Report of Board of Visitors to Bureau of Standards of the U. S. Department of Commerce. This is entitled Miscellaneous Publication No. 63, and can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents. The Report covers such topics as construction of standards, physical and chemical constants, scientific research, industrial research, importance of the Bureau's work, etc.

Elimination of Waste. Simplified Practice Recommendation No. 25. To be had at the U. S. Government Printing Office, Washington, D. C., for 5 cents. This particular issue deals with hot water storage tanks and explains how certain manufacturing economies can be realized by subscribing to the specifications cited.

Tenth Annual Report of the National Committee for the Prevention of Blindness, issued by the Committee at 130 East 22nd Street, New York City. The Report deals with the past and the proposed activities of the Committee and touches upon a number of matters concerning a very important field of service.

School Lighting as a Factor in Saving Sight. This pamphlet is issued by the Eye Sight Conservation Council of America, Times Building, New York City. The title explains the purpose of the brochure which is officially known as Eye Sight Conservation Bulletin 6. Price 10 cents.

Waterways and Inland Seaports. Prepared by Brig. Gen. T. Q. Ashburn, U. S. A., Chairman and Executive, Inland Waterways Corporation. Published by the U. S. Government Printing Office. General Ashburn has brought together much useful information, and has covered his subject as far as practicable within the limited space of 32 pages. Price per copy 10 cents.

Reed Air Filter Company, in Louisville, Kentucky, have issued two folders entitled, respectively, Reduce the Cost of Free Air, and Clean "Fuel Air" for Oil Engines. These folders should be of interest to many persons.

THE AIR-LIFT SYSTEM

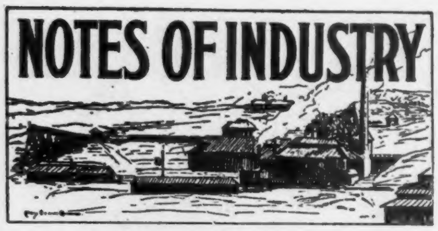
THIS is the title of a copiously illustrated bulletin recently issued by the Ingersoll-Rand Company, 11 Broadway, New York City, and to be had free upon request by anyone interested in this method of pumping water by compressed air.

The brochure is based upon the wide experience of the Ingersoll-Rand Company which has been engaged in the development and the sale of the air-lift system from its inception as a commercially practicable method of pumping. This period covers an interval of substantially 32 years. The advantages of the air lift, how it can be utilized, and much engineering data regarding the installing and the operating of air lifts are contained within the 37 pages of this authoritative pamphlet. It brings this important subject up-to-date, and calls attention to the fact that the use of this system of pumping water is growing steadily and that it finds applications in many parts of the world.

THE AIRPLANE REACHING TOWARDS MATURITY

THOSE who know most about the airplane are foremost in predicting its great future. Sir Alfred Yarrow, after making an extensive trip up our west coast and across Canada, returns to England to predict that the flying machine will virtually monopolize high speed travel across the Atlantic and make the rush of the great ocean liners superfluous. The business airplane, as he foresees it, is to fly at great heights with enclosed cabins in which normal air pressure is maintained.

Sir Sefton Brancker, British Controller of Civil Aviation, in the course of a lecture on *Imperial Air Routes to India and Australia,* gave comparisons of present airplane performance with that of the war time. Then the machines could fly only about 250 hours between overhauls, while now the period of service for cross channel machines is from 1,500 to 2,000 hours. The cost of freightage is now less than one-half, being about $1.25 per ton-mile, at a speed of 95 miles per hour. "Imperial Airways" is charging less than 5 cents a pound per hundred miles. America's magnificent distances offer great opportunities; and corresponding performances and records are inevitable.



Where a gasoline tax is levied for highway financing, the average motorist pays $10.30 a year.

On January 1, 1918, there were 10,631,586 savings account depositors, whose deposits aggregated $11,115,790,000. At the opening of business on January 2, 1925, depositors numbered 38,867,994, and their money in the banks amounted to $20,873,552,000.

Automotive vehicles have not decreased the number of horses in the country. There are now more than 20,000,000 of these animals in use.

The comic supplement has cost us, so it is said, 475,687,361 acres of standing timber required to make the newsprint used.

In 1800 the average length of life was 33 years; and since 1855 this has been raised to 58 years.

Through standardization small power electric bulbs can now be bought at a price 10 to 13 cents below that hitherto charged.

Italian industries continue active, especially the cotton textile plants, and unemployment is steadily decreasing. General financial conditions have improved.

The tobacco manufacturing industry in the United States is among those branches of production which maintain the most consistent growth from year to year. For instance, in 1900 our factories turned out 5,566,000,000 cigars, and the output in 1924 was 6,658,000,000. Cigarettes to the number of 3,259,000,000 were manufactured in 1900, while the production in 1924 totaled 71,024,000,000.

A nickel steel containing from 34 to per cent. of nickel has a zero temperature co efficient, so that it neither expands nor con tracts when heated or cooled; and an allo containing 46 per cent. of nickel has the sam temperature coefficient as glass, and is, there fore, largely used for leading-in wires in in candescent light bulbs, where in the earlier day of the industry platinum was thought to be i dispensable.

Within the last four years water power pro duction in Quebec has increased 40 per cent. in Ontario the output has increased 50 per cent. and in British Columbia development has adde 25 per cent. to the capacity to generate ele tricity by water.

The present development of a hydro-electri energy in Canada is equivalent to the powe that might be obtained by the consumption $300,000,000 worth of coal annually.

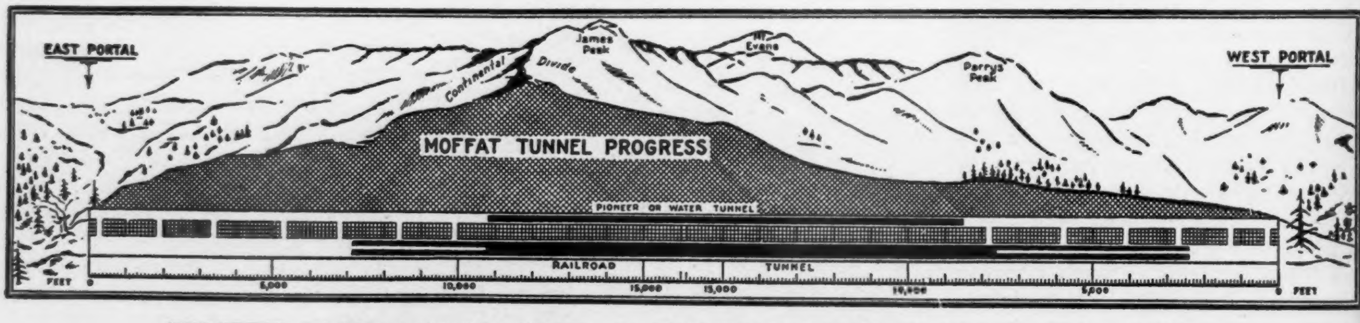
A consignment of Douglas fir sticks, con sisting of 29 spars, were recently shipped fro British Columbia—the longest of them requir ing three flat cars to carry them.

It has been predicted that the constructio of buildings in the United States in 1925 w call for the expenditure of $6,000,000,000.

During May of the present year there wa consumed in the United States 832,000,0 gallons of gasoline.

Hydro-electric power developments are bene fiting Switzerland perhaps more, proportionat ly, than any other country. From a report o the U. S. vice-consul at Zurich we learn th the stations at Waegittal, Lungera and Amst added 75,000 H. P. in 1924, so that Switze land can now claim a total of nearly 2,000,0 H. P. of hydro-electric energy profitably em ployed. An addition of 295,000 H. P. is prom ised in the near future from stations under con struction or extension.

The average price of a mile of concre roadway, with an 18-foot pavement and 7 inche thick is $30,000.



PROGRESS ON THE MOFFAT TUNNEL AS GRAPHICALLY RECORDED UP TO JULY 1st, 1925.

	East Portal	West Portal	Total	Per Cent. Finished
Water tunnel	10,707	8,446	19,153	60
Main headings	10,725	7,606	18,331	57
Crosscuts	441	378	819	63
Railroad tunnel (full size)	7,042	2,370	9,412	29

The unit cost of driving the water tunnel, crosscuts, and railroad bore (75 feet away) is lower than any similar work now under construction. We are indebted to Messrs. Hitchcock & Tinkler, Inc., contractors, for the foregoing information.

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